SEPTEMBER, 1952

# APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

INCLUDING AIR CONTROLS AND AIR CIRCUIT DESIGN; ELECTRICAL CONTROLS

NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS

CHICAGO
Sept. 4-5

Centennial of Engineering . . Page 63
How a Die Caster Met His Fluid Cost Problems . . . . . Page 68
Booster Actuated Holddown Cuts Shearing Costs . . . Page 71
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How To Determine Tubing Wall Thickness . . . . . Page 76

NCIH PROGRAM Page 61

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Vol. 5, No. 9

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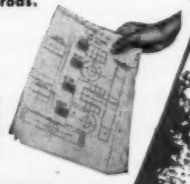

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# Fluid Power Lines

## Unique Circuits

Although the word "unique" is one we like to avoid, because what may be novel to one engineer can be old stuff to another, we think you'll find that the circuit used on the Ferriot rubber press is unique. Unlike many "unique" designs this circuit is simple and practical.

Elmer Heiser of the S. G. Morris Company who worked out the circuit with Ferriot, emphasized the limited requirements of this bank of rubber presses. The limited requirements permit the designers to provide a simplified circuit. To do so, required the modification of a standard four-way valve and the design of a special pilot check valve. Developing "tailor-made" circuits calls for knowledge of available components and a careful analysis of the job that the circuit must do.

## Machine Adjustments

"What provisions have you made so that the machine may be easily adjusted?" If it's a very hot day, you might be able to sell the boss on the idea that your design is so good that adjustments won't be necessary. However, on most machines, providing for quick machine set-up or adjustment is an important part of basic design.

In talking to Dick Olsen, of Kux Machine Co., who wrote this month's article, "Would Swivel Joints Speed Your Machine Adjustments?", we found that providing for adjustments is very important to the designers of die casting machines. Using swivel joints is one of the many design ideas incorporated on these machines to make it easier and faster for the user to change dies.

## Steel Processing

This month, two articles present special circuits used on steel processing equipment. One circuit, on a McKay peeler, opens large coils to start the steel through a leveler and into a shear. The circuit includes counterbalance valves for safe operation of the swinging cylinder operated peeler chisel.

The second article details a simple air-hydraulic booster circuit on a plate shear. Use of the booster results in a power system which can develop a high holddown pressure from shop air supply. The system has fewer components and is less costly than a full hydraulic system.

## Oil and Fire

Some time ago we ran an article which outlined some of the design precautions necessary to minimize the danger of fire on hydraulic equipment. Someone brought up the rhubarb that the article did not help to advance the use of oil power because it indicated that hydraulic systems could be hazardous.

The ostrich with his head buried in the sand while his tail feathers are being singed never did appeal to us.

This month you'll find an article which details the experience of the Johnson Motors Co. in converting their die casting machines from petroleum base to nonflammable fluid. If you're planning a similar changeover, we hope that you'll find the checklist which accompanies the article to be a helpful guide.

---

In this issue, you'll find the complete program of the eighth annual National Conference on Industrial Hydraulics which is being held September 4 and 5 at the Sherman Hotel in Chicago.

Otto J. Maha, vice president, Hannifin Corporation, is the Conference Director this year.

Twenty technical papers discussing the problems and the application of hydraulics in the automotive, instrumentation, machine tool, aircraft, tractive equipment and materials handling fields will be presented. Short abstracts of several of the papers are published in this issue.

The conference, sponsored by Illinois Tech, in cooperation with ten engineering societies, will be held in conjunction with the Centennial of Engineering.

*Otto J. Maha*
*Conference Director*

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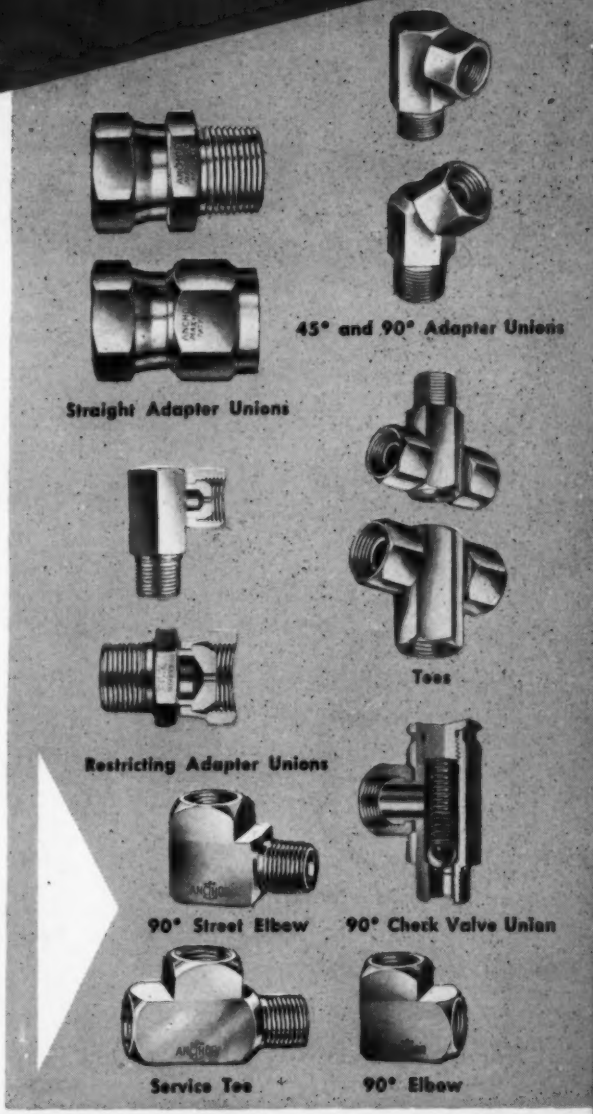


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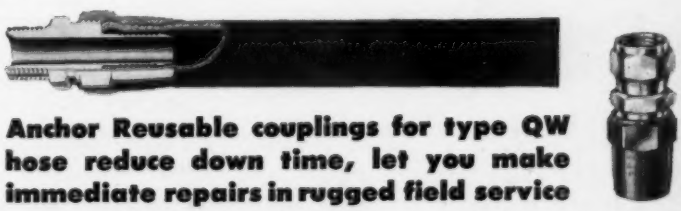

### Anchor Reusable couplings for type QW hose reduce down time, let you make immediate repairs in rugged field service

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# LETTERS to the Editor

We have a situation involving a number of power cylinders to be actuated by 200 psi oil pressure. There would be 48 such cylinders in a straight line of approximately 7 foot center. Each cylinder has a 4½ in. diameter, the stroke is 6½ in., the cylinders are double acting and have no piston rods. The cylinders are to be arranged so that maximum of 16 cylinders would operate at any one time at a rate of 4 strokes per minute, placing a load of 7.2 gpm each on the system. Any number up to 16 cylinders would be in operation for as long as 90 seconds. We are interested in finding a source for a hydraulic power unit to properly operate these cylinders and maintain a minimum of 190 psi when in operation. We estimate the maximum loading on the system would be 115.2 gpm.

C. HENRY SMITH
*Engineering Department*
*Flynn and Emrich Co.*

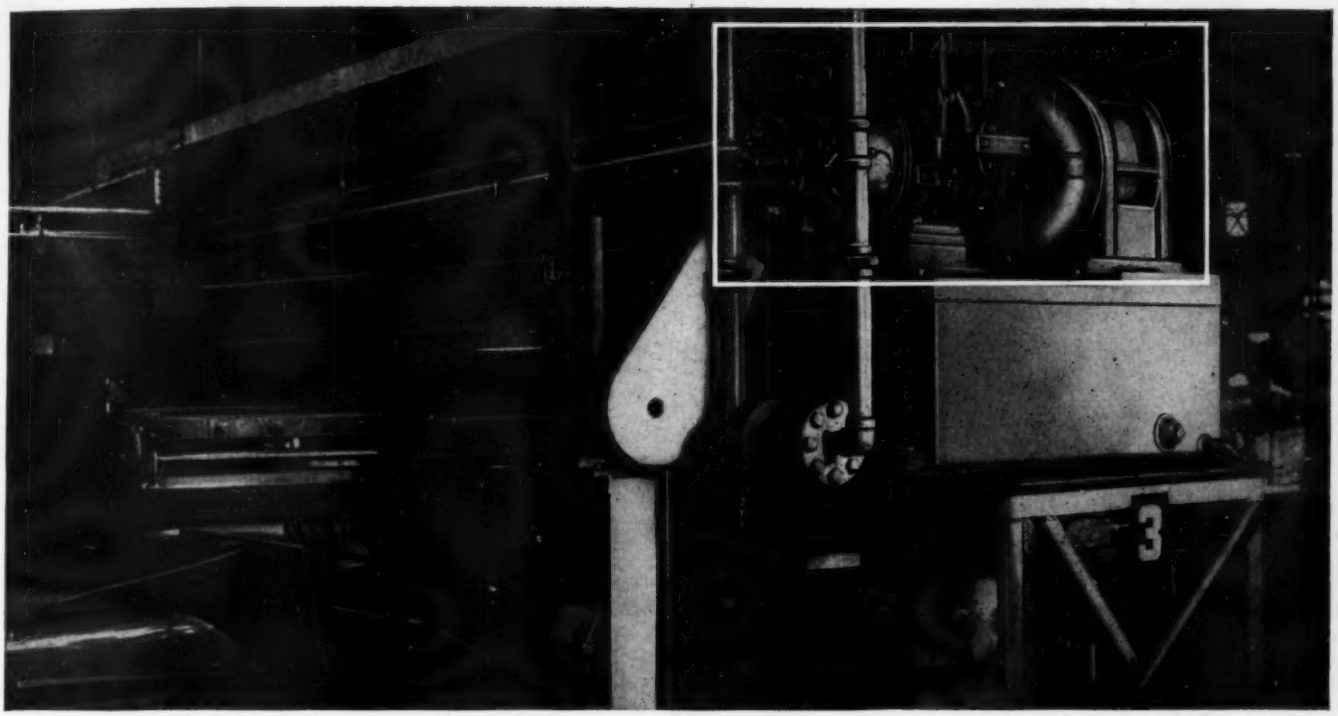
*We believe that any of the manufacturers of gear pumps that offer the size you require would be able to take care of your requirement. Among these are Geo. D. Roper Corporation, 714 Blackhawk Park Ave., Rockford, Ill.; Tuthill Pump Company, 939 E. 95th St., Chicago 19, Ill.; Viking Pump Co., 4th & Boose St., Cedar Falls 1, Iowa;* and *Worthington Corporation, Harrison, N. J.*

---

I would appreciate receiving six copies of your excellent pamphlet "Know Your Component Symbols" —one each for the engineers in my group. Also, if you still have copies of the 1952 APPLIED HYDRAULICS Data List, I would appreciate a copy. We find your magazine extremely helpful and interesting.

HENRY C. RECHTIEN, JR.
*Hydraulic Servo Engineer*
*McDonnell Aircraft Corp.*

*Six copies of "Know Your Component Symbols" and a copy of the APPLIED HYDRAULICS Data List have been forwarded to you. We appreciate that you find this magazine useful to you.*



# "Stretcher-leveler" makes wrinkles flat . . . and it's powered by a

# HELE-SHAW PUMP

BEFORE STAINLESS STEEL SHEETS are run through fabricating machines, they must be absolutely smooth and flat. And at the Eastern Stainless Steel plant in Baltimore this important operation is performed by a "stretcher-leveler" every motion of which is hydraulically actuated by a Hele-Shaw Pump.

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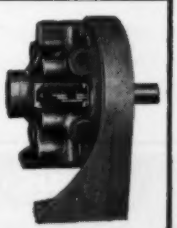

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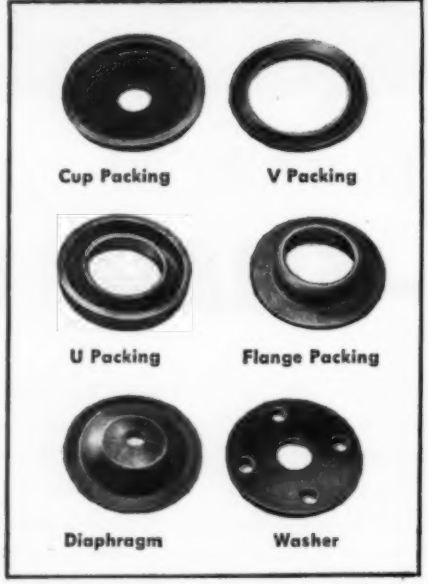


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Will you give me the names of firms that make what is commonly known as "Snubbers". It is a sort of check valve that is put in the line just before the hydraulic gage and is used to protect the gauge.

W. WALLACE MCKAIG
*McKaig's*
*Cumberland, Md.*

*Among companies that offer units of this type are Logansport Machine Company, 40 Payson Road, Logansport, Ind.; Greer Hydraulics, Inc., 454 18th St., Brooklyn 15, N. Y.; and Sprague Engineering & Sales Co., 1144 W. 135th St., Gardena, Calif.*

---

Please forward two copies of the article "Trapped Air in Hydraulic Systems" by J. C. Stringer and K. N. Hastings, which appeared in your May, 1952 issue. Will you please direct the copies to the attention of the Planning and EngineeringOffice, Erie Ordnance Depot, Lacarne, Ohio.

JAMES S. STEWART
*Assistant, Headquarters*
*Erie Ordnance Depot*

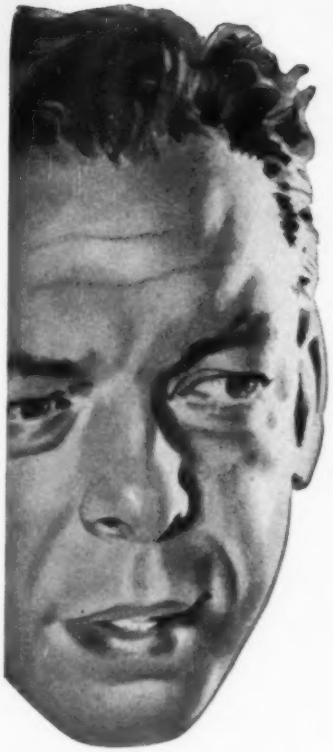
*These copies have been forwarded to you. This article, incidentally, is the first of a series from English authors to appear in APPLIED HYDRAULICS.*

**The new, larger supply of "Know Your Component Symbols" has been received and the backlog of requests received are being processed as rapidly as possible. Single copies to individuals and small lots to organizations will be mailed upon request. The booklet is also available in quantity lots at nominal rates.**

I would like to obtain copies of the following: Applied Hydraulics Data List, A Beginners Course in Basic Hydraulics and Know Your Component Symbols. These and others have proven useful in the development field.

JOS. F. SIBLEY
*Design & Development Engineer*
*F. J. Stokes Machine Co.*

*We are sending copies of the Data List and Know Your Component Symbols to you. The Beginners Course in Basic Hydraulics has not been reprinted. However, a new edi-*



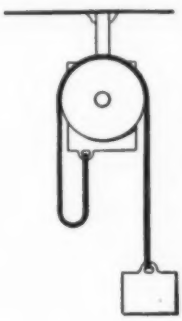
# TENSION LINKAGE

## WHAT'S THAT?

Some designers have been asking us what we mean by the term "tension linkage." We use it to describe any chain application in which the linear movement of the chain is not continuous in direction. The predominant feature of a tension linkage application is that the chain need not be formed as an endless chain belt.

There is a wide variety of possible tension linkage applications.

### here's one example

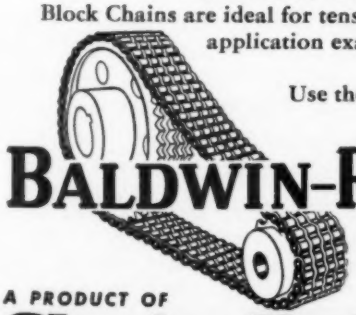


**Suspension of the load on a chain hoist.** The load is lifted or lowered by the rotation of the sprocket. One end of the chain is permanently anchored as indicated. The free end is fastened to the object to be lifted or lowered. The sprocket is driven by hand power or motor power through gearing. The slack side of the chain usually hangs freely, thus providing 180° wrap on the sprocket.

### here's another one

**Reposition of a shaft that has been rotated through a limited angle.** The shaft is turned clockwise (as shown in the illustration) during some operation of the associated equipment. The resulting compression of the spring provides the energy necessary to return the shaft to its original position. In many cases of this type, operation is frequent and high shock loads are encountered, so *chain* is the answer.

Our Bulletin No. 51-10 contains complete details on why Baldwin-Rex® Roller Chains, Leaf Chains and Block Chains are ideal for tension linkages. It also contains application examples and tables of weights, strengths and dimensions. Use the coupon to send for it today.



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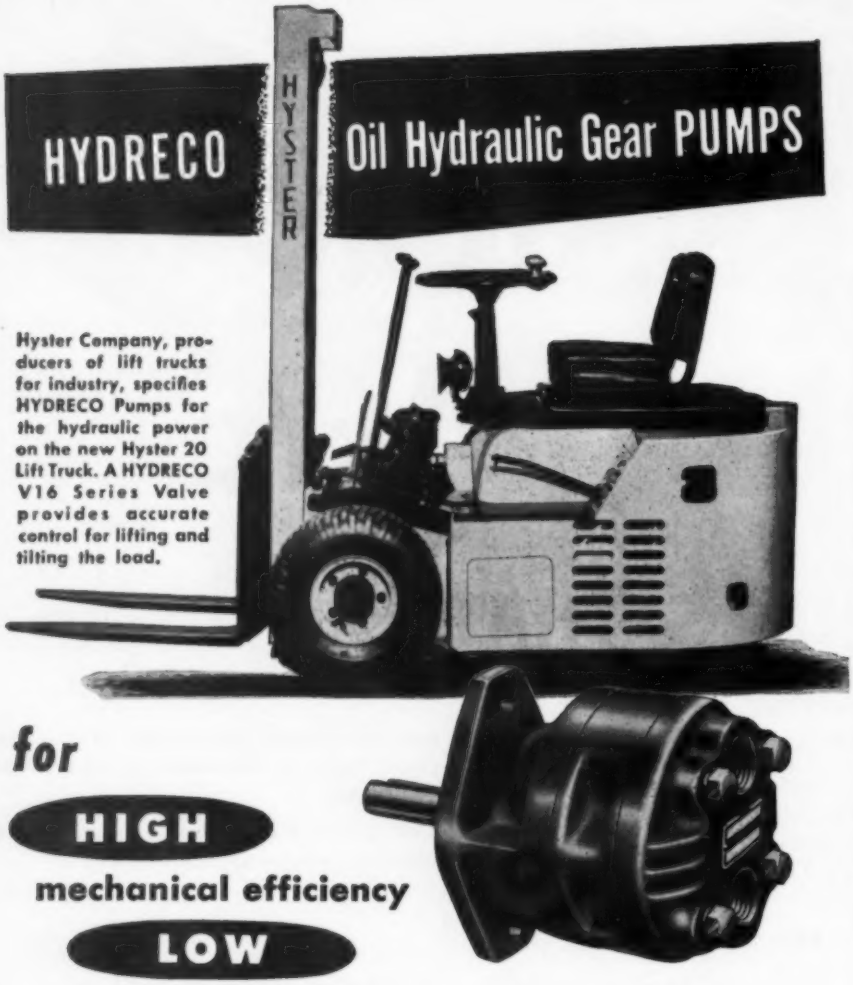
*City*.....*State*.....

HYDRECO Oil Hydraulic Gear PUMPS




Hyster Company, producers of lift trucks for industry, specifies HYDRECO Pumps for the hydraulic power on the new Hyster 20 Lift Truck. A HYDRECO V16 Series Valve provides accurate control for lifting and tilting the load.

for

HIGH

mechanical efficiency

LOW

operating cost

HYDRECO Pumps are specifically designed and produced for original equipment installations. HYDRECO designs give you the advantage of volume production on many standard component parts, while also providing mounting or other modifications that your application may require. Many standard designs and stock models are also available in several basic sizes up to 65 GPM.

Our engineers will gladly show you how HYDRECO Pumps with their high efficiency and low operating cost, mean savings for users and profits for you. Please write us.

HYDRECO A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

1104 EAST 222nd STREET • CLEVELAND 17, OHIO

## Letters to the Editor

*tion of the Navy training test "Basic Hydraulics" is now available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. at* $1.00 *(paper cover).*

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I would appreciate your sending the 1952 Data List as offered in your January issue.

A. JENTSCH
*Engineer*
*National Union Radio Corporation*

*A copy of the* 1952 *Data List has been sent you.*

---

We receive your magazine and read it with a great deal of interest each month. In the June issue was an advertisement by Sundstrand Machine Tool Company describing control valves that can be stocked together for compactness. We have requested more information from this company. We would like to have the names of other manufacturers that offer similar valves.

C. F. MCGINTY
*Mechanical Engineer*
*Schlumberger Well Surveying Corp.*

*Sundstrand Machine Tool Co. was one of the first to offer this type of valve which they call multiple section valves. Several other leading hydraulic valve manufacturers offer component valves that can be stacked together. Among these are: Vickers, Inc.,* 1400 *Oakman Blvd., Detroit* 32, *Mich.; Hydreco,* 1104 *East* 222*nd St., Cleveland* 17, *Ohio; and Double A Products, Manchester, Mich.*

---

I would greatly appreciate receiving the enlarged 1952 APPLIED HYDRAULICS Data List including information on hydraulics and pneumatics, engineering manual, etc.

D. L. SCHONWALD
*Engineering Dept.*
*Eastern Industries, Inc.*

*A copy of the* 1952 *Data List has been forwarded to you.*

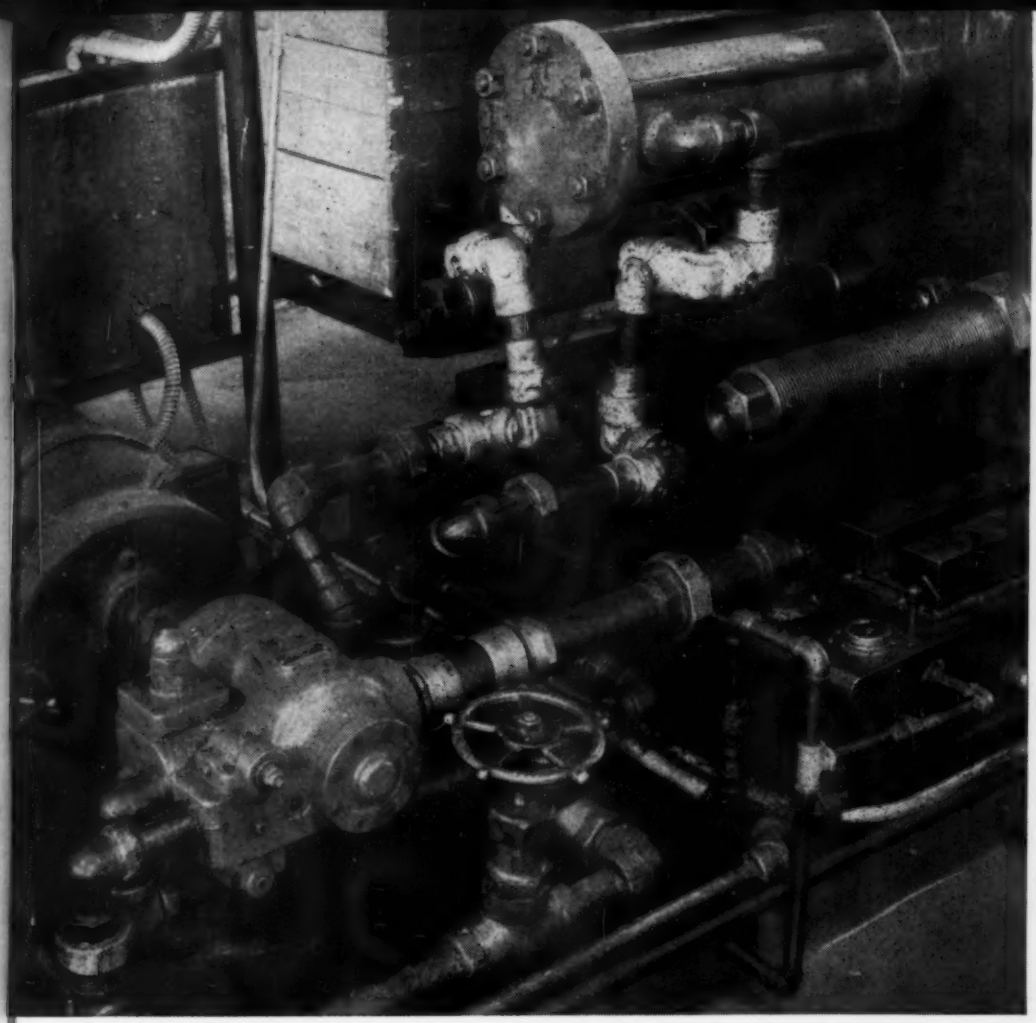
---

It appears from catalogs on hand that "O" rings of 16 in. diameter (dash number 87) are the largest commercially available. Could you give us the name of a manufacturer, if any, from whom "O" rings of larger diameter (up to 24 in.) could be procured? If not available, could



Circle 72 on Reader Service Card

Circle 136 on Reader Service Card



# 5 years, no change of oil

THIS midwestern die casting company called in a Standard Oil lubrication specialist when operations were started over five years ago. One of his recommendations specified the use of STANOIL Industrial Oil No. 18 in the hydraulic unit of the die casting machine shown. Now, after five years of service, this original oil is still in nearly perfect condition. There is no deposit and no varnish in the hydraulic system. There has been no need to clean the system.

This performance is typical of the results gained by STANOIL users who count on its greater oxidation stability and corrosion resistance to deliver trouble-free lubrication in speed reducers, head stock gears, auxiliary turbines, and compressors, as well as hydraulic systems.

The Standard Oil lubrication specialist in your own area can help put the advantages of versatile STANOIL Industrial Oil to work in your plant now. A call to your local Standard Oil (Indiana) office is all that's necessary. Why not do it today?

Standard Oil Company, 910 South Michigan Ave., Chicago 80, Ill.

**STANOIL**
TRADE MARK
**Industrial Oil**

## What's your problem?

**D. R. Clay,** lubrication specialist at Standard Oil's Grand Rapids office, helped this manufacturer put hydraulic system lubrication on a trouble-free basis with STANOIL Industrial Oil.

One of a corps of such specialists, he makes his headquarters close to the plants he serves. He offers on-the-spot lubrication service that is backed by extensive experience and training in the application of modern lubricants and fuels. The same service is available to you wherever you are located in the Midwest through the lubrication specialist in your own locality.

Arrange today for a visit by this specialist. Just phone or write the Standard Oil Company office nearest you. When he calls, ask for actual performance data on these outstanding products:

**SUPERLA Greases**—Available in a wide range of consistency grades and in both lime-soap and soda-soap types, SUPERLA Greases cover a wide range of operations.

**STANORUST Rust Preventives**—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specially developed for its intended use. The grades range from a fingerprint remover to a heavy semi-solid that protects against corrosion for years under the most severe outdoor exposure.

**STANDARD OIL COMPANY** STANDARD *(Indiana)*

Keep your hydraulic oils, and coolants clean with . . .

# SPARKLER FILTERS

designed specifically for this purpose. A practical protection for hydraulic machinery and cutting tools

The VR filter is designed for filtering hydraulic oil, quenching oils, transformer oil, solvents and other industrial liquids.

The Sumptype filter is ideal for filtering coolants. The filter plate assembly is attached to the intake pipe of the circulating pump and the coolant is drawn through the filter discs and delivered clean and free from all metal particles and grit, to the nozzels.

★ Clean hydraulic oil greatly prolongs the life of all moving parts, such as pistons, cylinders, pumps, valves, etc.

★ Filtering hydraulic oil extends the life of the oil. Drain and leakage oil may be reclaimed. One large user of hydraulic machinery saved $90,000.00 in hydraulic oil alone in one year by filtering oil with Sparkler Filters.

★ Filtering hydraulic oil eliminates sticking and clogging of valves and reduces down time and maintenance cost. A prominent authority on hydraulic machinery says that 70% of servicing and repairs is due to the improper condition of hydraulic oil.

★ Filtering coolant fluid removes all fine metal particles and grit from grinding wheels that is pumped back to nozzles unless a filter is employed in cleaning up the return coolant.

★ Clean filtered coolant prevents scratching and flat spots on work piece and increases the life of grinding wheels and cutting tools. Reduces the frequency of dressing grinding wheels.

The Sparkler VR filter is constructed on a simple filtering principle using filter paper as a media. The filter plates can be removed easily for cleaning which consists only of removing the dirty paper and replacing with fresh sheets. Any shopman can make this change of paper in a few minutes. The cost of replaced paper is less than a dollar per change.

*Let a Sparkler representative demonstrate these filters in your plant*

**SPARKLER MANUFACTURING CO.**
**Mundelein, Ill.**

REPRESENTATIVES IN ALL PRINCIPAL CITIES

you suggest the best type of static seal or gasket, preferably a self sealing type, to be used on the rear end of a hydraulic cylinder at 2000 psi working pressure. At present we are using solid copper gaskets, but under repetitive stress and certain amount of shock load they begin to leak after a relatively short time.

G. W. JANKOWSKI
*Mechanical Engineer*
*Hamilton Bridge Co., Ltd.*
*Hamilton, Canada*

*While "O" ring sizes larger than* 16 *in. in diameter are not stocked by leading manufacturers, some of them do have molds for making larger sizes and larger rings may be obtained at somewhat longer delivery dates. Since you propose to change from a solid copper gasket to an "O" ring, it will be necessary for you to determine the groove dimensions and finishes, as well as the operating temperatures, so that the "O" ring manufacturer will be able* to make a definite recommendation. A *tear sheet from our* 1952 *Directory listing the manufacturers of "O" rings has been sent you.*

**Requests for back issues containing the first installments of Beginners Course in Basic Pneumatics have about exhausted copies. It is suggested that copies containing these installments be preserved. It is expected that this series will be made available in reprint form after the series has been completed.**

Would you please send a set of tear sheets of the article "How to Design Hydraulic Reservoirs" by W. T. McCormick in the May issue of APPLIED HYDRAULICS.

J. Ross
*Agricultural Engineer*
*Hawaiian Canneries Co., Ltd.*

*A set of tear sheets of Mr. McCormick's May article have been sent to you.*

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Reference is made to your July issue of APPLIED HYDRAULICS in which Mr. Wright K. Gannett, chief engineer of the Mast Development Co., requested specific data on a valve which operated on the principle of squeezing a hose together or a flexible diaphragm against a metal surface. With the wide selection of materials available for a hose or

**NEW LOCK NO. 2, MONONGAHELA RIVER.** First ship through on June 1, 1951 was U.S. Steel's "Homestead." A special feature of the lock is an emergency dam, at the upstream end, which can be raised or lowered as needed.

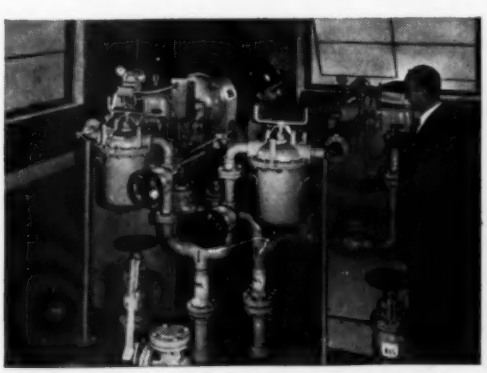
# ENGINEERS PICK SUN HYDRAULIC OIL FOR NEW LOCK ON MONONGAHELA

Last year the Monongahela, busy river that flows past Pittsburgh's Golden Triangle, carried 2,000,000 more tons of shipping than the Panama Canal. This year its tonnage promises to be higher still, for on June 1 the U.S. Army Corps of Engineers put in operation their new Lock No. 2, near Braddock.

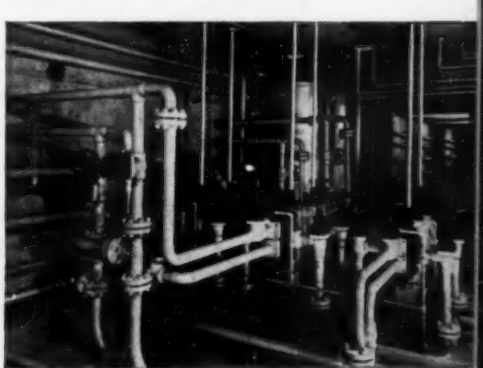
The entire mechanism of this lock... gates, butterfly valves, and capstans... operates hydraulically, and a Sun Hydraulic Oil was chosen as the medium. Why? Because this vital job required an oil that would prevent corrosion and rust; that would retain its original specifications for the life of the equipment; and that would flow freely at low temperatures, yet not thin out at high. The engineers in charge chose a Sun Hydraulic Oil over all other oils because they felt it could be best counted on to keep the lock in operation and river traffic moving.

For complete information on Sun Hydraulic Oils and recommendations as to their use in your operations, write for booklet AH-9.

**HYDRAULIC CAPSTANS,** operated by Sun Hydraulic Oil, are used when tows, too long for the locks, have to be broken up into units and pulled through mechanically.



**SYSTEM'S HEART,** operating the lock mechanisms, is a pair of Oilgear hydraulic pumps. They supply 2,800 gallons of Sun Hydraulic Oil at pressures up to 1,100 psi.



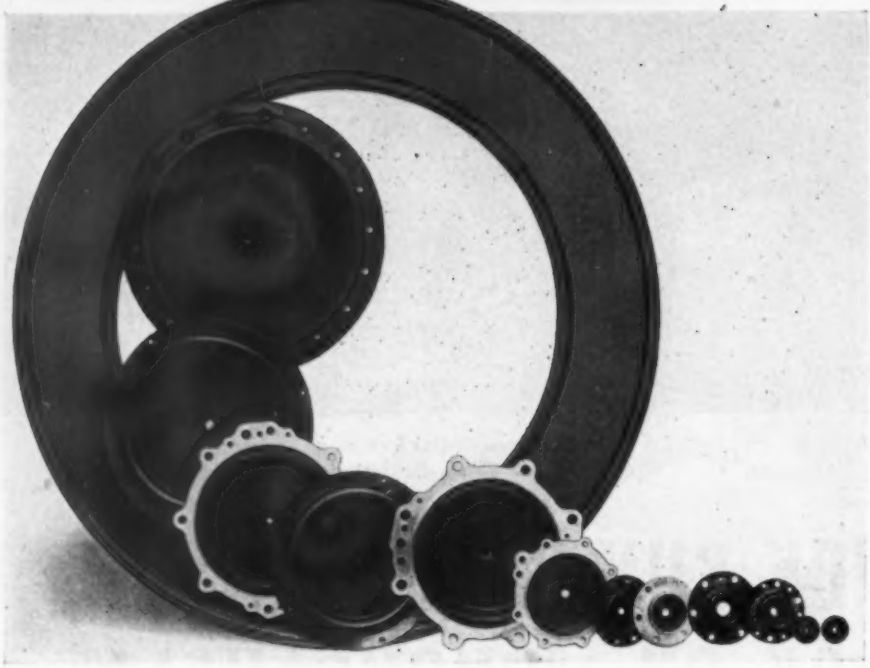
**UNDERGROUND SYSTEM** of pipe lines supplies all hydraulic devices. It is designed so that it will continue to function even though the chamber is completely flooded.

**SUN INDUSTRIAL PRODUCTS**

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO

# DIAPHRAGMS



## FOR ALL INDUSTRIAL APPLICATIONS

One of Acushnet's many specializations is in the field of diaphragms. We have achieved notable success in the design, development and molding of all types of diaphragms, with or without fabric inserts, from the size of a dime up to three feet in diameter.

Special stocks are expertly compounded with properties to resist various fluids and gases, extreme high or low temperatures, or combinations of these requirements. We are fully equipped to produce rubber diaphragms bonded to metal. Problems involving the most meticulous specifications are invited.

Acushnet
PROCESS COMPANY

*Send for a copy of the "Acushnet Rubber Handbook", a comprehensive rubber data reference for molded rubber parts.*

*Address all communications to 794 Belleville Ave., New Bedford, Mass.*


diaphragm, such as Teflon, Buna N and many other types of flexible plastics, Mr. Gannet should have no trouble finding a material suitable for his particular application.

I might point out that the Hills-McCanna valve (Saunders patent) can be furnished as a quick operating on-off valve by the addition of a pneumatic actuating cylinder or a diaphragm motor. Should Mr. Gannett require a high pressure valve (200-1000 psi), the Grove Regulator Co., 6529 Hollis St., Oakland 8, California, make a valve called a "Flexflo Valve", which operates on the principle of synthetic rubber tube stretched over a metallic cylindrical core. The upstream pressure of the fluid is allowed to surround the rubber tube, preventing any liquid from passing through the valve proper. When this pressure is vented to atmosphere and its source shut off by a pilot valve, the internal pipe fluid pressure expands the rubber tube allowing the upstream fluid to flow around the center cylindrical core and pass on to the downstream side of the valve.

GEO. D. COOK
*Project Engineer*
*Rocket Department*
*Curtiss-Wright Corp.*
*Propeller Division*

*Thanks very much for this information. A copy of your letter and the literature you enclosed is being forwarded to Mr. Gannett.*

---

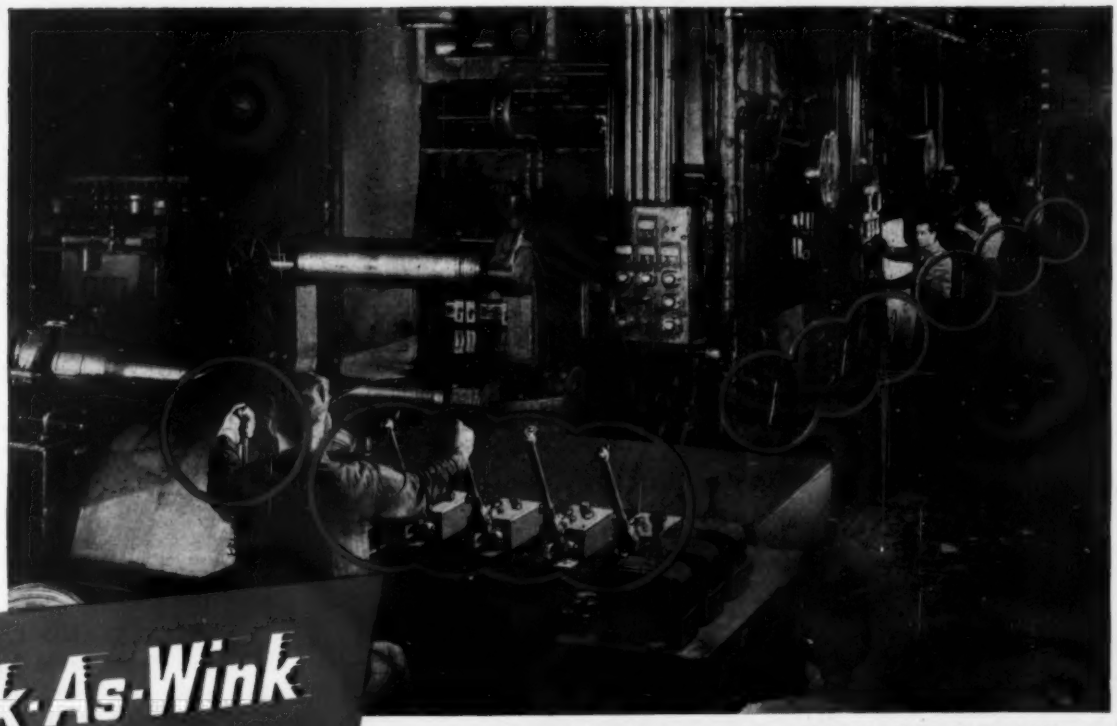
*EDITOR'S NOTE: C. J. Bain, Picatinny Arsenal, Dover, N. J., also wrote us suggesting the Saunders valve as a solution to Mr. Gannett's problem.*

Do you have any copies of "A Beginners Course in Basic Hydraulics"? I would appreciate receiving a copy.

JOHN GRICIUS
*Ordnance Engineer*
*Pitman-Dunn Laboratory*
*Frankford Arsenal*

*As noted elsewhere in this column this month, this series has not been reprinted. We recommend the new edition of "Basic Hydraulics" as one of the best introductions to the subject.*

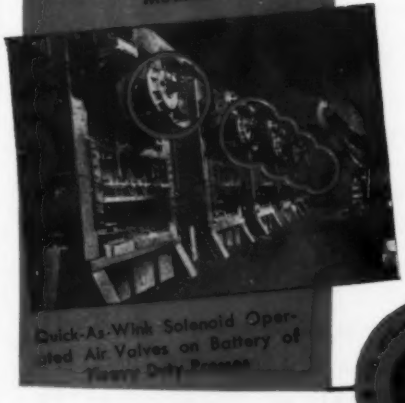
**Reprints or tearsheets of articles in past issues are furnished promptly in the order requested. Relatively few copies of APPLIED HYDRAULICS older than 3 months are still available. The supply of the 1952 Directory issue (January 1952) has been exhausted.**



View of Quick-As-Wink Hydraulic Valve Installation in Steel Mill

# Quick-As-Wink Control Valves

Quick-As-Wink Completely Enclosed Diaphragm Operated Air Valves on Core Making Machine



Quick-As-Wink Solenoid Operated Air Valves on Battery of Heavy Duty Presses

## *smooth month-after-month performance*

## *minimizes your down-time*

● Gambling with breakdowns, lost production and plant tie-ups just doesn't pay. Play safe! Install Quick-As-Wink Valves on *all* your air and hydraulic controls. Positive and fast acting, all operating parts of Quick-As-Wink Valves are in pressure balance, eliminating any tendency to creep or crawl. Quick-As-Wink Valves can be serviced easily and quickly, during normal maintenance periods, usually without disturbing connecting piping. There is no metal to metal seating. All parts are standardized and readily interchangeable, avoiding the delay of returning valves to the factory for servicing, and the expense of maintaining large standby inventories. Standardize on Quick-As-Wink — and get *all* the advantages that *only* Quick-As-Wink Valves can give you.

# Quick-As-Wink
## AIR AND HYDRAULIC
# Control Valves

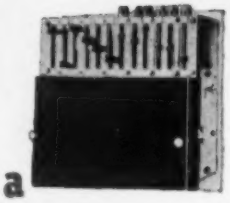
*Hand, Foot, Cam, Diaphragm and Solenoid Operated*

**Mfd. by C. B. HUNT & SON, INC., 1911 East Pershing St., Salem, Ohio**



Circle 68 on Reader Service Card

# EAGLE builds a timer for every timing problem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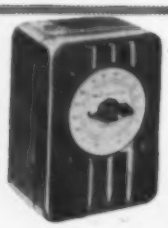
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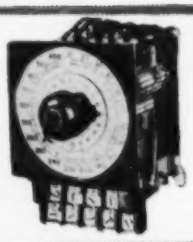
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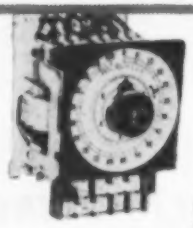
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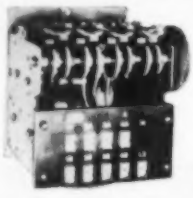
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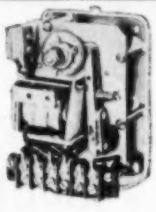
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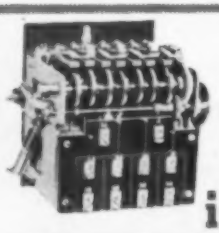
Because of Eagle Signal's great variety of precision timing devices, they are in a position to suggest the exact timer required for your individual industrial problem. Let Eagle help speed up production and save countless man hours for you. Write for Bulletin 340.

EAGLE SIGNAL *Industrial Timers*

EAGLE SIGNAL CORPORATION MOLINE, ILL.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a. MULTIFLEX (Multiple Circuit) Reset Timer . . . closes and opens one or more circuits during a time interval started by push button, limit switch, etc.

b. DURAFLEX Reset Timer . . . holds circuit closed for preset time after "start" button is pressed.

c. CYCL-FLEX Reset Timer . . . opens or closes a circuit after an adjustable time period.

d. FLEXOPULSE Repeat Cycl Timer . . . closes and opens a contact repeatedly as long as synchronous motor is energized.

e. MICROFLEX Reset Counter . . . opens or closes a contact after a preset number of impulses.

f. MICROFLEX Reset Timer . . . opens or closes a circuit after an adjustable time period.

g. POLYPULSE (Multiple Circuit) Program Timer . . . closes or opens one or more circuits in a repeating series of operations.

h. TIMOFLEX . . . a time delay relay for opening or closing a circuit.

i. POLYFLEX (Multiple Circuit) Reset Timer . . . closes or opens one or more circuits during a time interval started by push button, limit switch, etc.

j. MANUFLEX Timer . . . used where a device is turned "on" manually, runs a selected time and stops automatically.


## LITERATURE AND SERVICES OFFERED IN THIS MONTH'S ADS

*For more information circle numbers on the reader service card bound in this issue.*

HYDRAULIC EQUIPMENT, manufactured by Adel Division of General Metals Corp., is described in bulletins available upon request. Included are hydraulic control valves, power pumps and other units.

Circle 4 on Reader Service Card

VALVES AND CYLINDERS made by Rivett Lathe & Grinder, Inc., are fully described in catalog sections available from this company. Catalogs on air valves (Catalog section 303), air cylinders (Catalog section 55), hydraulic valves (Catalog section 203) and hydraulic cylinders (Catalog section 105) may be obtained.

Circle 124 on Reader Service Card

TELESCOPING SLEEVES for the protection of hydraulic cylinders exposed to contaminated atmospheres are described in Bulletin AH-1, offered by A & A Mfg. Co.

Circle 1 on Reader Service Card

PRECISION SEALS are described in a comprehensive "O" ring catalog containing design and installation data, prepared by The Darcoid Co., Inc.

Circle 32 on Reader Service Card

"O" RINGS designed to withstand a wide range of operating conditions are listed in Catalog C issued by Goshen Rubber and Manufacturing Co., Inc. Design and installation data are detailed.

Circle 56 on Reader Service Card

HYDRAULIC DIFFERENTIAL RELIEF VALVES are featured in a bulletin now being mailed by Gre-San Manufacturing Co.

Circle 58 on Reader Service Card

# LINDBERG HYDRAULIC CYLINDERS

**... now available for pressures to 3000 PSI**

**For extra power applications, it'll pay you to investigate the new Lindberg line of hydraulic cylinders for operation up to 3000 PSI ... ruggedly and heavily designed for extra performance. Added to the 1500 PSI hydraulic cylinders, this line gives you a selection from 0 to 3000 PSI ... and supplements the Lindberg line of air cylinders.**

*Check these Lindberg features* for dependable, low cost power for lifting, forcing, pulling, pressing, pushing and clamping:

**ROTATING CAPS** ... Caps can be easily rotated in order to position ports for piping. Just remove cap screws, and revolve head cap ... it isn't necessary to disassemble cylinder. This feature permits simplified piping, and frequently eliminates need for T-fittings or elbows.

**NO TIE-RODS** ... Welded flange construction eliminates need for tie-rods ... insures proper alignment.

**PACKING RESISTS OIL AND TEMPERATURE** ... Chevron type piston rod packing is made of special asbestos cloth and rubber compound ... resists high temperature ... is not affected by oil.

**NEOPRENE O-RINGS** ... Conventional gaskets are replaced by Neoprene O-rings. Sealing action is automatic ... the higher the pressure, the tighter the seal.

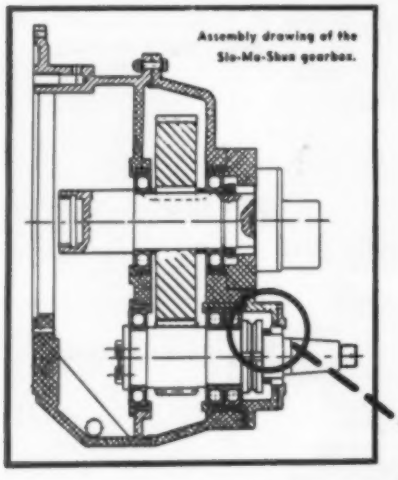
**SOCKET-HEAD CAP SCREWS** ... All screw heads are in the open and easily accessible from outside the cylinder. It is not necessary to partially disassemble cylinder to tighten screws.

Lindberg 3000 PSI Hydraulic Cylinders come in 8 mounting types and 10 bore sizes from 2" to 8".

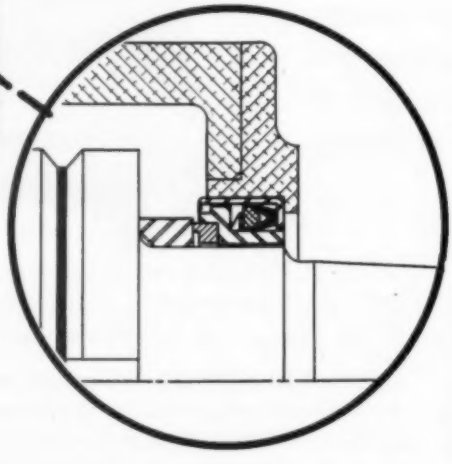
## LINDBERG AIR & HYDRAULIC DIVISION

Lindberg Engineering Company • 2441 West Hubbard Street • Chicago 12, Illinois

# World's fastest boat uses "SEALOL" Seal


Assembly drawing of the Slo-Mo-Shun gearbox.

When Slo-Mo-Shun IV set a new world's hydroplane record of 178.497 miles per hour, a "Sealol" Rotary Shaft Seal was on board for the ride. To drive the boat at such a terrific speed, the full power of an Allison V-12 aircraft engine is transmitted through a 3:1 step-up gearbox, driving the propeller shaft at speeds in excess of 12,000 rpm.



Western Gear Works, designers and manufacturers of the step-up gearbox, selected "Sealol" to seal the high speed output shaft against oil leakage. Many factors influenced this selection. Compactness, lightweight, minimum frictional drag, ability to withstand ultra-high shaft speeds — these are the major reasons why "Sealol" was chosen for the job.

While Mr. Stanley Sayres has been setting speed records with Slo-Mo-Shun IV, "Sealol" has been setting performance records in shaft sealing... Pressures in excess of 1000 psi — or temperatures of 600°F. — or rubbing speeds of 16,000 linear ft. per min.... demonstrate some of the unusual performances possible with "Sealol" Seals.

Perhaps your unusual problem can be solved by Sealol. Send blueprints and specifications to our engineering department at Sealol Corporation, 45 Willard Ave., Providence 5, R. I. Plants Nos. 1 and 2 in Providence. Plant No. 3 in Keene, N. H. Offices in Philadelphia, Cleveland, Chicago, Los Angeles, Montreal, Toronto.

**SEALOL**

**The Balanced Pressure Seal**


AIR CONTROL VALVES featuring a new method to control air pressure, are illustrated in Bulletin 231, offered by Hannifin Corporation.

Circle 63 on Reader Service Card

QUICK CONNECT COUPLINGS for pneumatic service are listed, with full data, in literature prepared by Hansen Manufacturing Co.

Circle 64 on Reader Service Card

TUBE FITTINGS featuring an alloy spring steel sleeve are described in Catalog No. 502, prepared by Flodar Corporation.

Circle 44 on Reader Service Card

AIR AND HYDRAULIC EQUIPMENT are described in several catalogs issued by the Logansport Machine Co.

Circle 90 on Reader Service Card

NONFLAMMABLE TYPE FLUID for hydraulic applications where high heat or fire hazards are problems, is described in a booklet "Pydraul F-9", published by the Monsanto Chemical Co.

Circle 101 on Reader Service Card

AIR VALVES for every job are described in Catalog 52-A issued by Mechanical Air Controls, Inc.

Circle 96 on Reader Service Card

PACKINGS, which help reduce production and maintenance costs of hydraulic equipment, are listed, with complete engineering data, in literature available from Chicago Rawhide Manufacturing Co.

Circle 27 on Reader Service Card

PRECISION MOLDED PACKINGS offered by Periflex, Inc. are described in their catalog, now available from this company. The list of molds carried in stock is included.

Circle 112 on Reader Service Card

AIR VALVES which feature interchangeability are listed in a new catalog offered by Numatics.

Circle 106 on Reader Service Card

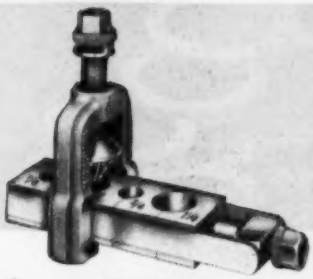
# IMPERIAL *Leader in Tubing Tools*

## *Announces a Complete Line for*

# HYDRAULIC and PNEUMATIC APPLICATIONS

## FLARING

***37° FLARING TOOL*** flares SAE 1010 soft steel and other metal tubing to JIC standards. Easy, single lever clamping. One compact tool, **No. 437-F,** flares six sizes—3/16", 1/4", 5/16", 3/8", 1/2", 5/8" O.D. Tubing.

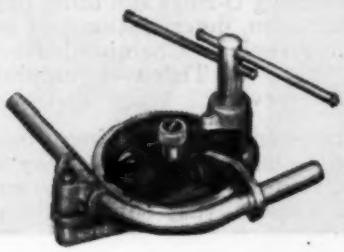


***FOR LARGER SIZES.*** This 37° Flaring Tool has rollers in flaring cone which make flaring of larger sizes easier. Automatically burnishes flares. **No. 537-F** flares 3/4", 7/8", 1", 1-1/4", O.D. Tubing.

***MAKES 37° FLARES TO AN STANDARDS.*** Handles aircraft grade stainless steel tubing. Has flare control gage. Automatic burnishing action. **No. 400-F** flares 3/16", 1/4", 5/16", 3/8", 1/2", 5/8" O.D. Tubing.

## BENDING

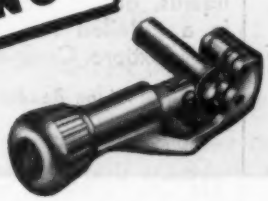
***FULL RANGE TUBE BENDER.*** Bends 6 sizes of JIC steel and most other tubing—1/4", 5/16", 3/8", 1/2", 5/8" and 3/4" O.D. inclusive. Furnished complete with necessary mandrels in convenient steel chest. Economical. Compact. **No. 350-F.**



***UNIVERSAL GEAR-TYPE BENDER.*** *Will bend any type of tubing,* including hard temper, heavy wall steel. Also pipe. High gear ratio makes bending easier. **No. 270-F.** Individual Benders for each size of tubing 3/8" to 1-1/8" O.D.

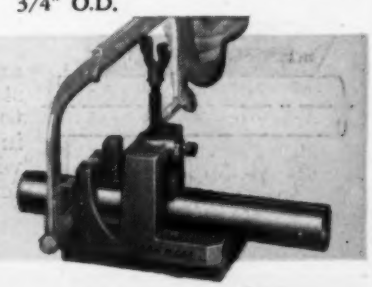
***BENDS AIRCRAFT GRADE STAINLESS STEEL TUBING.*** Also all other metal tubing. Worm gear drive. Manual operation. **No. 600-F** Tube Bending Tool, complete in metal kit, bends six sizes of tubing 1/4" to 3/4" O.D.

## CUTTING



***HI-DUTY TUBE CUTTER.*** Has ball bearing action, flare cut-off groove in rollers. Retractable reamer. **No. 274-F** for 1/8" to 1" O.D. Tubing. **No. 312-F** for 1/4" to 1-3/8" O.D. Tubing.

***SLIDE-TO-SIZE TUBE CUTTER.*** Provides instant adjustment to tubing size. Just push handle and cutting wheel slides right down to work. Quick ratchet release. **No. 206-F** cuts tubing 3/4" to 2-1/4" O.D.



***SAWING VISE FOR ALL KINDS OF TUBING.*** Assures perfect right angle cuts. Quick slide-to-size clamping — with instant ratchet release. **No. 384-F** for tubing 3/16" to 1-1/2" O.D.

**THE IMPERIAL BRASS MFG. CO., 1242 W. Harrison St., Chicago 7, Illinois**

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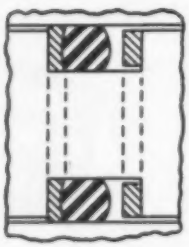
***Ask for "Tool Bulletin Set H". See Your Supply House***

**Pioneers in Tube Fittings and Tubing Tools**

# TEFLON PACKINGS

## for Hydraulic & Pneumatic Cylinders, Presses, Pumps, Valves

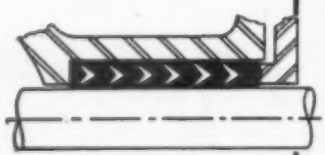


### CHEMISEAL BACK-UP RINGS

**Protect Packing — Lengthen Its Life**

For protecting O-rings and other packing from extrusion, deterioration and loss of efficiency—select Chemiseal Back-up Rings, made of Teflon—a natural for hydraulic service.

These rings are chemically inert, can't be affected by oils or solvents. They won't harden, soften, swell or shrink in service. Tough, resilient, they support the packing with which they are used, greatly lengthen its life. Try them, and you will standardize on them.



### CHEMISEAL V-TYPE PACKING

The ideal valve packing that seals with low gland pressures and operating torque, made from solid Teflon or Teflon compounds. Extremely resilient, tough and anti-hesive—it cannot seize the valve stem or shaft—is long wearing, impervious to all hydraulic fluids, outlasts other packings several times over. Supplied in sets with square-end Teflon adaptors. Send for catalog No. 810 V.

*du Pont's trademark for its tetrafluoroethylene resin

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**CAMDEN 1, NEW JERSEY**


TENSION LINKAGES, Bulletin 51-10, published by Chain Belt Company, contains complete details, application samples and tables of weights, strengths and dimensions.

Circle 26 on Reader Service Card

SWIVEL JOINTS which are self-aligning, prevent leakage, are free from binding and absorb vibration are illustrated in Bulletin 269, which will be sent by Barco Manufacturing Co.

Circle 16 on Reader Service Card

AIR FILTER LUBRICATORS to keep compressed air lines clean and air valves lubricated, are described in a bulletin published by Air Conversion Research Corp.

Circle 5 on Reader Service Card

ELECTRIC MOTORS for hydraulically operated equipment are described in engineering data issued by Electro Dynamic Division, General Dynamics Corporation.

Circle 40 on Reader Service Card

BLADDER TYPE ACCUMULATORS, which give efficient power to operate components even when pumps fail, are described, with full specifications, in Bulletin 301 prepared by Greer Hydraulics, Inc.

Circle 60 on Reader Service Card

BALL VALVE which can't leak and which is equally applicable for liquids, gas or steam, is described in a detailed folder published by The Foxboro Company.

Circle 46 on Reader Service Card

AN OIL PURIFIER which helps prevent trouble in hydraulic installations by keeping oil clean and free from damaging contamination, is described in a bulletin offered by Honan-Crane Corporation.

Circle 66 on Reader Service Card

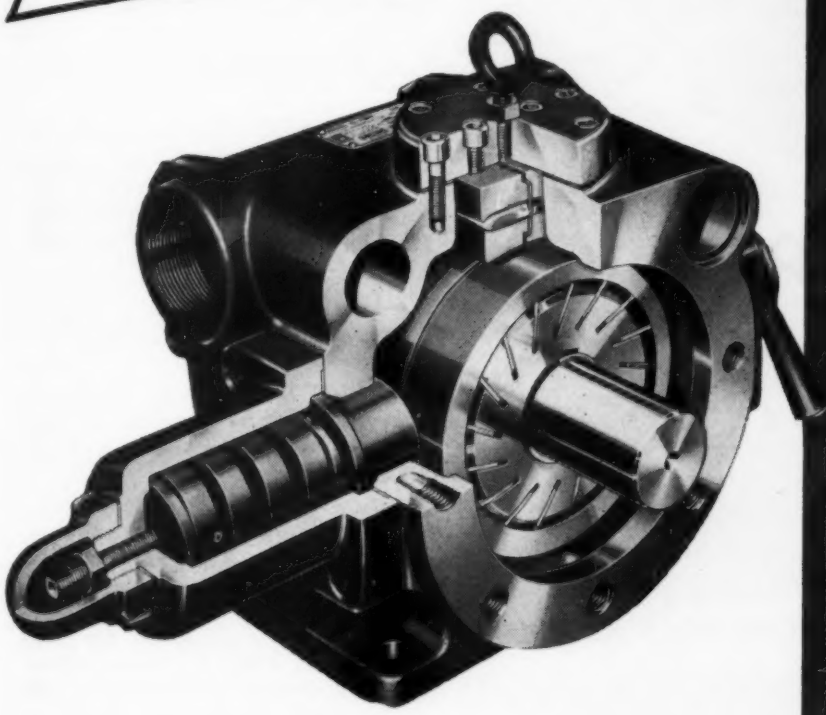
HYDRAULIC PUMPS and fluid motors for a wide line of industrial applications are listed in Catalog C-800, issued by Eastern Industries, Inc.

Circle 39 on Reader Service Card

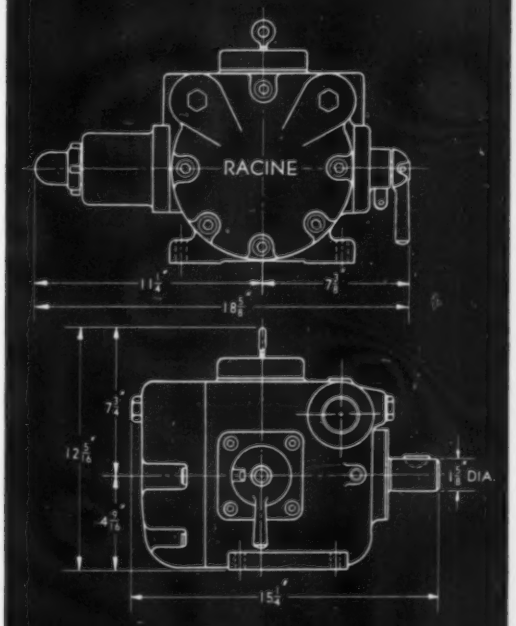


Circle 148 on Reader Service Card

# *New* RACINE 70 gpm VARIABLE VOLUME PUMP



- ★ 70 GPM AT 1200 RPM
- ★ VARIABLE VOLUME
- ★ PRESSURE COMPENSATED GOVERNOR
- ★ LEVER VOLUME CONTROL
- ★ FOOT MOUNTED
- ★ MAX. WORKING PRESSURE—1000 PSI




This new Model K 70 gpm Variable Volume Oil Hydraulic Pump is an important addition to Racine's broad line of hydraulic products. It is equipped with a pressure compensating governor which automatically regulates the maximum pressure to the hydraulic system and provides safe and adequate over-pressure protection.

An additional manual lever control regulates the volumetric onput of the pump to meet circuit requirements.

*Write for complete descriptive catalog on Model K 70 gpm Oil Hydraulic Pump*

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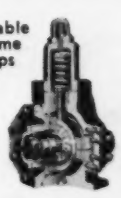
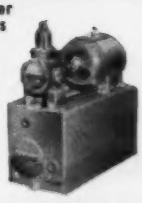
Four-Way Valves

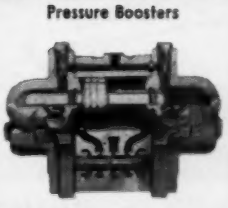
Variable Volume Pumps



Power Units



Pressure Boosters



RACINE

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**2074 ALBERT STREET, RACINE, W**

# KENYON

## 3000 psi
## SHUTTLE VALVE
### AN6277-4

Kenyon's policy of simplicity of design has again paid off. Kenyon's latest AN Approved Shuttle Valve is another product of a company policy demanding simplification and improvement of design which has resulted in lower manufacturing costs and stepped-up production.

Kenyon's slide valve type of shuttling action and use of Lubrited steel parts preclude the possibility of seizure or wear and assure smooth action. Positive sealing is provided by entrapped AN 6227 "O" rings which cannot be "washed out". These and AN 6290 gaskets are the only non-metallic parts in the assembly.

**The Kenyon 3000 PSI SHUTTLE VALVE (AN 6277-4), like all other Kenyon Hydraulic Products, has been proven by service to be suitable for use in Mineral Base MIL-O-5606 or Water Base MIL-F-7083 (AER) Hydraulic fluid.**

KENYON'S SHUTTLE VALVE DELIVERIES ARE ON SCHEDULE AT A LOWER COST TO THE CONTRACTOR

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## INSTRUMENT CO., INC.
## HUNTINGTON STATION, L. I., N. Y.

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SPECIAL CYLINDERS, manufactured by Hydro-Line Manufacturing Co., are featured in Bulletin A-750. Construction and performance are covered.

Circle 159 on Reader Service Card

PACKING UNITS which prolong the effective life of hydraulic cylinders are described in literature available from Hydraulic Accessories Co.

Circle 69 on Reader Service Card

AUTOMATIC RING PACKING, designed to protect itself against damage by gland pressure, is described, with full engineering data, in Bulletin PK-58A, issued by Johns-Manville.

Circle 78 on Reader Service Card

ROTARY PUMPS for hydraulic service are fully detailed in Catalog 952, isued by Geo. D. Roper Corporation.

Circle 126 on Reader Servcie Card

"O" RINGS for hydraulic and pneumatic applications are fully described, with full engineering design and application data, in the "O" Ring Handbook offered by Precision Rubber Products Corporation.

Circle 117 on Reader Service Card

TUBE FITTINGS and their applications are detailed in Catalog 4300, issued by The Parker Appliance Co.

Circle 111 on Reader Service Card

MULTI-PURPOSE GREASE, which provides correct lubrication for practically all normally loaded antifriction and plain bearings, is described, with specifications, in pamphlet BRB No. 1, published by Socony-Vacuum Oil Co., Inc.

Circle 132 on Reader Service Card

HEAT EXCHANGERS, which help to eliminate harmful temperature rises in hydraulic fluids, are outlined in a new Bulletin 1.1K5, issued by Kewanee-Ross Corporation.

Circle 80 on Reader Service Card

SOLENOID CONTROLLED air power valves are described in Bulletin AV-300, offered by The Bellows Company. Case histories, diagrams, technical data on the Electroaire valve are included. Bulletin CL-30, featuring controlled air power devices, is also available.

Circle 18 on Reader Service Card

"O" RING TUBE COUPLINGS are the subject of Bulletin AH 101, issued by Lenz Co.

Circle 87 on Reader Service Card

HYDROMOTOR, a simple, dependable, maintenance-free source of reciprocating rotary power, both air and oil, is fully described with application and engineering data in Bulletin 21, issued by the Hydromotor Division, The Bonnet Company.

Circle 74 on Reader Service Card

LIMIT SWITCHES built in a variety of types and sizes to fit practically every industrial application, are described and illustarted in Engineering Bulletin EM-51, published by the National Acme Co.

Circle 103 on Reader Service Card

CYLINDER CONTROL VALVES for long wear and leakfree service are detailed in Catalog 552, issued by W. H. Nicholson & Co.

Circle 105 on Reader Service Card

HIGH PRESSURE HYDRAULIC CYLINDERS, with full specifications on sizes mountings, etc., are published in illustrated Bulletins A 104 and A 105, issued by Miller Motor Co.

Circle 97 on Reader Service Card

AIR, WATER AND HYDRAULIC CYLINDERS for a wide range of industrial applications are the subject of a catalog available from Ortman-Miller Machine Co., Inc. Also available are 1/2 and 1/4 scale templates for all cylinders and mounting brackets.

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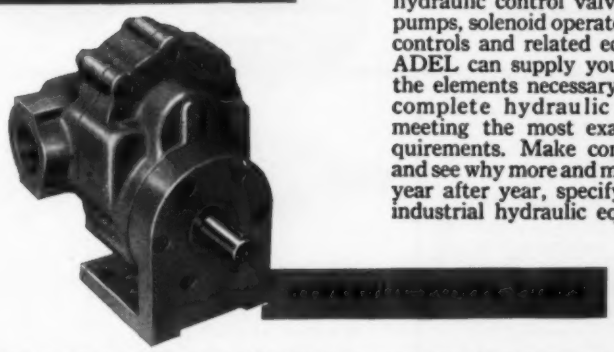
For fourteen years ADEL has continuously directed its energies to the advanced development and production of high-quality hydraulic equipment. With the most modern facilities in our 150,000 square foot plant, we build ruggedness, efficiency and compactness into each ADEL unit. The variety of equipment being manufactured has been steadily expanded until today it encompasses a complete line of hydraulic control valves, power pumps, solenoid operated remote controls and related equipment. ADEL can supply you with all the elements necessary to build complete hydraulic systems meeting the most exacting requirements. Make comparisons and see why more and more users, year after year, specify ADEL industrial hydraulic equipment.



A FEW SELECT TERRITORIES ARE STILL AVAILABLE TO PROGRESSIVE DISTRIBUTORS OF HYDRAULIC EQUIPMENT. INQUIRIES INVITED.

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Manufacturers of Industrial Hydraulic Valves and Pumps

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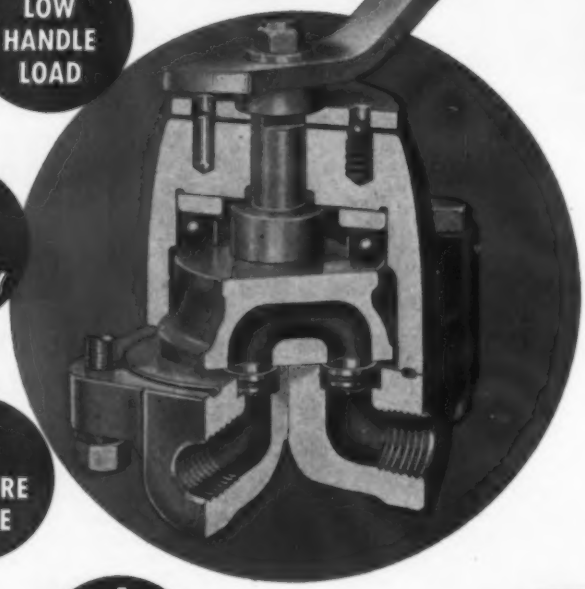
# COMPARE *Shear-Seal* CHARACTERISTICS
## WITH OTHER VALVE PRINCIPLES



1 LEAK PROOF

2 LOW HANDLE LOAD

3 HIGH FLOW CAPACITY

4 NO PRESSURE WASTE

5 NO WIRE-DRAWING

6 EXCELLENT THROTTLING

7 COMPACT SIZE

8 NOT CRITICAL TO DIRT

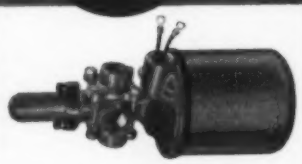
9 LONG SERVICE LIFE

10 LOW MAINTE-NANCE

1. Leak proof closure for vacuum to 6000 psi water, hydraulic oil, and air is accomplished by pressure loaded self aligning 'Shear-Seal's' mating with optically flat slide or rotor.
2. Easy non-fatiguing operation at 6000 psi due to generous ball bearings and pressure balanced sealing members.
3. Large, smooth, tubular flow passages –
4. Unobstructed by poppets or spools.
5. Flow is through the hole in the center of the 'Shear-Seal' and never across sealing surfaces.
6. The smooth valve operation permits infinite throttling.
7. Through proper engineering and production know-how Barksdale Valves have none of the bulkiness usually associated with high pressure valves.
8. The square corner wiping action between 'Shear-Seal' and rotor keeps dirt and pipe scale away from sealing surfaces.
9. Under the continued lapping action of the metal to metal seals "Barksdale Valves wear-in where others wear-out."
10. No lubrication required – no freeze ups even where valve is seldom operated.

**Vacuum to 6000 psi** manual valves to 1½" pipe size are standard in the following flow patterns: shut off, manipulator, 4-way selector, and dual pressure selector. All manual valves may be remote operated with the aid of auxiliary air actuators.

Bulletin 2G-B

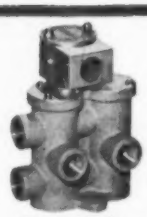


**Vacuum to 3000 psi** Solenoid 'Shear-Seal' valves are available in the smaller pipe sizes, including shut off, 2-way diverters, 3-way, 4-way, and 3 position 4-way selector valves.

Bulletin 1B-2

**Vacuum to 10,000 psi** Barksdale and Meletron pressure actuated switches include heavy duty piston type, Bourdon tube and diaphragm type switches for **all** services.

Bulletin 2M-R



**0 to 250 psi** Crescent fast cycling, continuous duty Solenoid valves will operate up to 600 cycles per minute on air, water and light oil; pipe sizes from ¼ to ¾ inch.

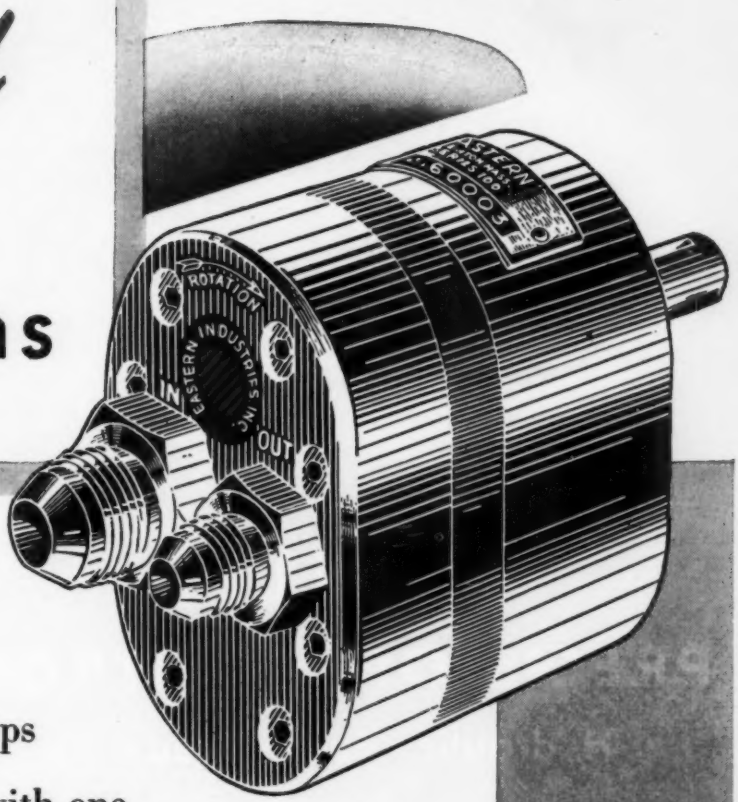
Bulletin 1046

**For complete technical information see our catalog in Sweet's file for product designers or write for the bulletins covering the specific products listed above.**

# BARKSDALE VALVES

1566 EAST SLAUSON AVENUE · LOS ANGELES 11 · CALIFORNIA

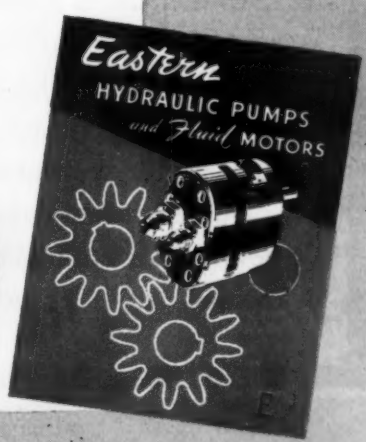
# *Designed* for your applications




Eastern's line of hydraulic pumps and fluid motors are designed with one objective in mind: *to supply an economical, reliable and compact unit for the heart of your hydraulic mechanism.*

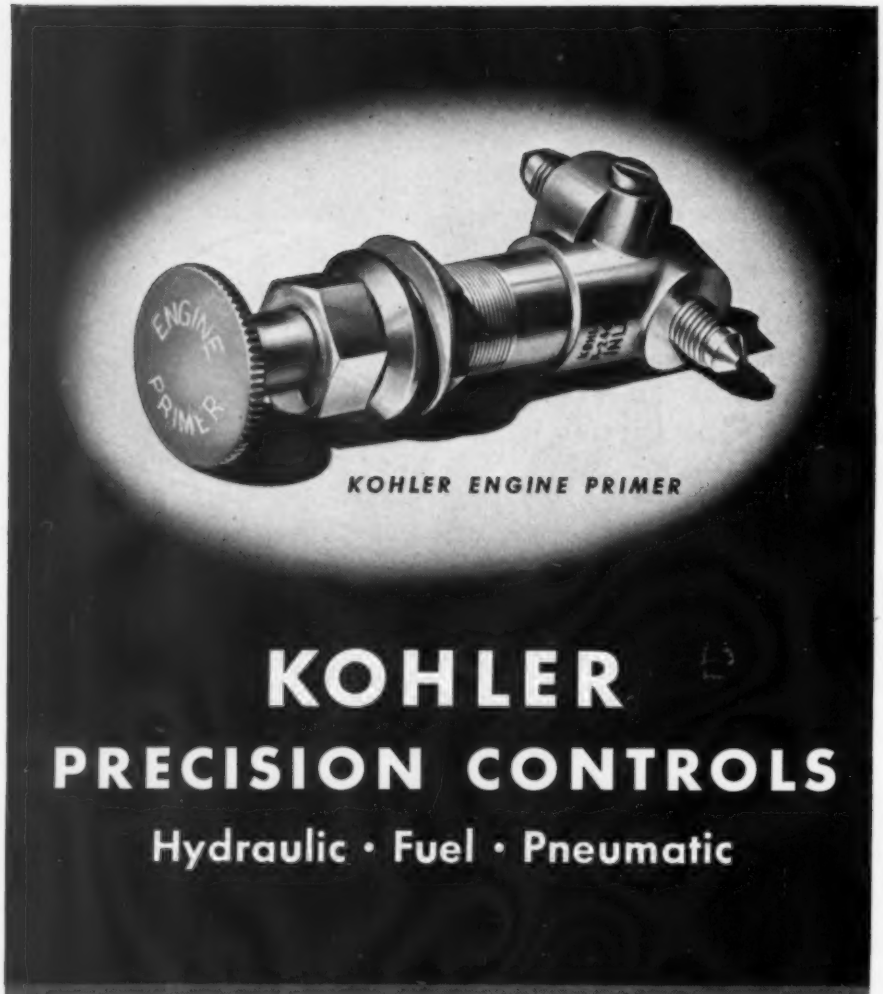
You will find a combination of exclusive features in Eastern products which will make your selection a confident one.

## HYDRAULIC PUMPS FLUID MOTORS




***Send for Eastern's brand new Hydraulic Catalog C-800. Contains valuable engineering diagrams and information.***

**Eastern INDUSTRIES INCORPORATED**
**296 Elm Street, New Haven, Conn.**



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## PRECISION CONTROLS
### Hydraulic • Fuel • Pneumatic

The Kohler Engine Primer will operate efficiently at low temperatures, using Diesel oil, gasoline or ether to start internal combustion engines.

Kohler Co. is a leading supplier of precision controls to manufacturers of Diesel engines, automobiles, trucks, tractors, jet engines, military, commercial and private aircraft, agricultural and industrial test equipment.

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AIR-COOLED ENGINES • PRECISION CONTROLS


**HYDRAULIC CYLINDERS**, rugged and sturdily designed for extra performance, are described in a 28 page Bulletin 701, issued by Lindberg Air and Hydraulic Division, Lindberg Engineering Co.

Circle 88 on Reader Service Card

**INJECTION MOLDED "O" RINGS** for hydraulic and pneumatic system applications are listed, with full data, in the "O" Ring Catalog published by Minnesota Rubber and Gasket Co.

Circle 98 on Reader Service Card

**REDUCED MAINTENANCE**, maximum operating efficiency, ease of installation and service are outstanding features of high pressure hose assemblies, which are illustrated on catalog sheets, available from the Anchor Coupling Co.

Circle 12 on Reader Service Card

**TEMPERATURE CONTROL UNIT** which mounts and operates in any position has been detailed in literature issue by the Industrial Control Division of Sterling Inc.

Circle 138 on Reader Service Card

**TO KEEP HYDRAULIC OILS CLEAN** model filters provide large filtering area and other advantages which are detailed in model VR catalog offered by the Sparkler Manufacturing Co.

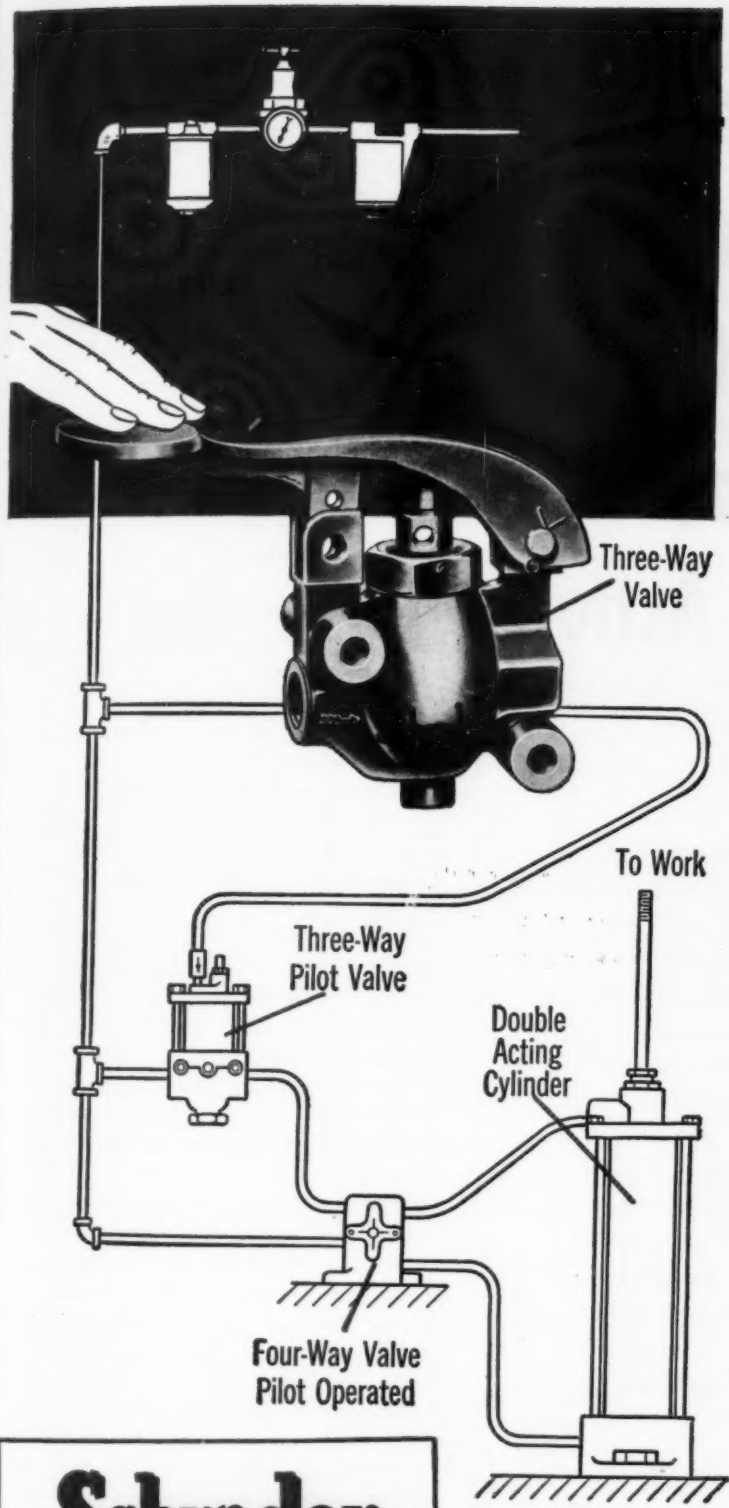
Circle 133 on Reader Service Card

**NEW LINE** of industrial hydraulic tube fittings, designed especially for application in hydraulic circuits, instrumentation and power systems are detailed in Catalog No. 52 available from the Deutsch Company.

Circle 35 on Reader Service Card

**WIDE RANGE** of hydraulic pumps simplifies selection. Choice of six sizes in capacities up to 37.6 gpm and up to 500 psi pressure are illustrated in a pump bulletin offered by Brown & Sharpe Manufacturing Co. Also shown are such features as interchangeable parts for each size of pump and reversible back drain to allow direction of rotation to be changed.

Circle 20 on Reader Service Card

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# Electrol Hand Pumps for Uniform 2-Way Pumping Action

The Electrol 525 Hand Pump has a volumetric capacity of 1.5 cu. in. per cycle.

The Electrol 770 Hand Pump has a volumetric capacity of of 2 cu. in. per cycle.

Electrol Double-Acting Hand Pumps are capable of delivering uniform volume, with operating pressures up to 1,500 P.S.I. They are compact in design . . . have few moving parts . . . are low in cost . . . economical in operation. They have built-in suction and pressure check valves . . . ⅜" pipe thread ports . . . and can be used in mineral oil or water. Also, there are similar units available for use in gasoline, kerosene, or equivalent aromatic fluids. Complete engineering data can be obtained on request.

Electrol INCORPORATED HYDRAULICS
KINGSTON, NEW-YORK

CYLINDERS • SELECTOR VALVES • FOLLOW-UP VALVES
CHECK VALVES • RELIEF VALVES • HAND PUMPS
POWERPAKS • LANDING GEAR OLEOS • SOLENOID
VALVES • ON-OFF VALVES • SERVO CYLINDERS • TRANSFER
VALVES • CUT-OUT VALVES • SPEED CONTROL VALVES

*Better Designed Products Use Electrol Hydraulics*


## Centennial of Engineering

THE Centennial of Engineering, to be held in Chicago, September 3 to 13, will be the greatest group of technical meetings ever brought together at one time. Marking the 100th anniversary of the founding of the American Society of Civil Engineers, 64 national and international societies will participate, many of them with full annual meetings.

One of the features will be a series of general convocation symposiums in which specialists and laymen alike will take part. These are in addition to regular society technical sessions.

Practically every national technical and engineering society will play a part. A record of more than 1000 leading scientists and technical figures will speak at various meetings. Many meetings, of course, will be simultaneous. However, visitors to Chicago will be afforded an opportunity to attend sessions of several societies during a two or three day period.

More than 30,000 engineers from all over the United States, supplemented by assured delegations from Canada, Latin America, Australia, North Africa, the Far East and practically all European nations outside of the Iron Curtain, each of the meetings is expected to be heavily attended.

The management of the Centennial of Engineering has taken over the Eighth Street Theater and the grand ball rooms of the Conrad Hilton, Sherman and La Salle hotels. These facilities are in addition to the sizable number of smaller meeting rooms that will be used in other hotels all over the Loop and the adjoining Lake Front area and the Centennial headquarter arrangements at the Museum of Science and Industry.

Among foreign visitors, the Mutual Security Agency at Washington has arranged to bring about 200 leading European engineers to this country to study American production methods.

The foreign group will arrive well ahead of the official opening date. After participation, the foreign group will divide into teams and be escorted to various production centers.

# Program of the

# National Conference on Industrial Hydraulics

THE sessions of the eighth National Conference on Industrial Hydraulics will be held at the Sherman Hotel, Chicago, Thursday and Friday September 4 and 5. Scheduled this year as an integral part of the Centennial of Engineering, the Conference is expected to attract the largest attendance in its history. The complete program, announced by Conference Director Otto J. Maha, is one of the strongest and best balanced group of sessions and of individual papers ever assembled for this series of meetings.

The National Conference on Industrial Hydraulics, sponsored by Armour Research Foundation and the Graduate School of the Illinois Institute of Technology, has the active cooperation of a group of ten engineering societies. These include; the Illinois section of the American Society of Civil Engineers; Chicago Section of the American Society of Mechanical Engineers; Chicago section of the Society of Automotive Engineers; Western Society of Engineers; American Society of Lubricating Engineers; Chicago Section of American Institute of Chemical Engineers; Chicago section of Institute of Aeronautical Sciences; American Society of Agricultural Engineers; Chicago chapter, Illinois Society of Professional Engineers and the Chicago chapter, American Society of Tool Engineers. An executive committee of fifteen members, representing industry and engineering schools, formed among the cooperating societies, have completed all arrangements, including speakers, chairmen and panel members, for an outstanding Conference.

The plan of holding concurrent sessions and the use of discussion panels will again be used. This will give the registrants and visitors an opportunity to select sessions or individual papers of most pertinent interest. The flexibility of this arrangement has won the approval of manufacturers and major users of hydraulic equipment as well as of distributors and dealers. The panel discussions will be both prepared and open to questions from the floor.

## PROGRAM

### THURSDAY, SEPTEMBER 4, 1952

8:30 A.M. Registration: Sherman Hotel, Bal Tabarin Parlor

9:45 A.M. Opening Remarks by: H. A. Leedy, Director, Armour Research Foundation of Illinois Institute of Technology, Chicago, Illinois

10:00 A.M. MORNING TECHNICAL SESSION
GENERAL SESSION: Bal Tabarin
Chairman: Philip H. Emrich, Manager, Products Service Department, Vickers, Incorporated, Detroit, Michigan
1) "Low Temperature Application of Industrial Hydraulic Oils". D. K. Nason, Technical & Research Division, Beacon Laboratories, The Texas Company, Beacon, New York
2) "Hydraulic Equipment, Design, Construction and Maintenance". J. R. Hemeon, Hydraulic Equipment Engineer, Ternstedt Division, General Motors Corporation, Trenton, New Jersey
Panel Members: Kurt O. Tech, Chief Engineer, The Cross Company, Detroit, Michigan; E. Wiedman, Chief Engineer, The Oilgear Company, Milwaukee, Wisconsin

12:30 P.M. LUNCHEON SESSION: Grand Ballroom
Chairman: O. J. Maha, Conference Director & Vice-President, Hannifin Corporation, Chicago, Illinois
Speaker: R. C. Binder, Professor, Mechanical Engineering, Purdue University, Lafayette, Indiana. "Educating the Hydraulic Engineer."

2:00 P.M. AFTERNOON TECHNICAL SESSIONS
AUTOMOTIVE: Old Chicago Room
Chairman: Harold E. Churchill, Director of Research, Studebaker Corporation, South Bend, Indiana
1) "Hydraulic Steering in General Motors Cars." C. W. Lincoln, Chief Engineer, Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Mich.
2) "Commercial Vehicle and Passenger Car Power Braking." W. R. Williams, Executive Engineer, Bendix Products Division, Bendix Aviation Corporation, South Bend, Indiana
Panel Members: P. J. Reese, Wagner Electric Corporation, St. Louis, Missouri; W. K. Creson, Vice-President, Ross Gear & Tool Company, Lafayette, Indiana

*J. R Hemeon*
*Ternstedt Division*
*General Corporation*

*Paul E. Butzin*
*Delta Power Tool Division*
*Rockwell Manufacturing Co.*

*Frank C. Mock*
*Bendix Products Division*
*Bendix Aviation Corporation*

*J. A. Lauck*
*Pesco Products Division*
*Borg Warner Corporation*

INSTRUMENTATION: Crystal Room
Chairman: E. N. Mortenson, Chairman, Chicago Section of American Institute of Chemical Engineers, Chicago, Illinois

1) "Instrument Maintenance in an Oil Refinery." William A. Theissen, Electrical & Instrument Departments, Whiting Refinery, Standard Oil Company of Indiana, Whiting, Indiana
2) "Air Operation of Hydraulic Gauges and Controllers in Water Filter Plants." A. A. Kalinske, Director of Development, Infilco, Incorporated, Tuscon, Arizona

Panel Members: R. H. Potts, Tech. Advisor, Armour Chemical Div., Armour & Co., Chicago, Ill.; B. S. Swanson, Jr., Assistant Professor of Chemical Engineering, Illinois Institute of Technology, Chicago, Illinois

PUMPS: Bal Tabarin
Chairman: O. E. Teichmann, Assistant Chairman, Applied Mechanics, Armour Research Foundation of Illinois Institute of Technology, Chicago, Illinois

1) "Design Features of a High Pressure Single Stage Rotary Vane Hydraulic Pump Motor." John R. English, Project Engineer, The Denison Engineering Company, Columbus, Ohio

"Noise in Hydraulic Pumps. "Professor E. L. Midgette, Head, Department of Mechanical Engineering, Polytechnic Institute of Brooklyn, Brooklyn, New York

Panel Members: W. R. Master, Engineering Laboratory, Vickers, Incorporated, Detroit, Michigan; W. E. Wilson, President, South Dakota School of Mines & Technology, Rapid City, South Dakota

5:45 P.M. SOCIAL HOUR: Parlors L, M, & O
(Your opportunity to meet the Speakers, Cooperating Society Representatives, Industrial Sponsors, and the Board of Governors and Committee Members of the Conference.)

6:30 P.M. ALL SOCIETY BANQUET:
Grand Ballroom
Toastmaster: F. W. Edwards, General Manager, Centennial of Engineering, Chicago, Illinois
Speaker: To be announced.

FRIDAY, SEPTEMBER 5, 1952

9:30 A.M. MORNING TECHNICAL SESSIONS
MACHINE TOOLS: Old Chicago Room
Chairman: Joel Jannenga, Chief Engineer, Greenlee Brothers and Company, Rockford, Illinois

1) "Techniques in Machine Tool Circuit Design." E. Y. Seborg, Chief Engineer, Barnes Drill Company, Rockford, Illinois
2) "Air-Powered Hydraulics." Paul E. Butzin, Chief Engineer and Clarence Johnson, Development Engineer, Delta Power Tool Division, Rockwell Manufacturing Company, Milwaukee, Wisconsin

Panel Members: To be announced

AIRCRAFT: Bal Tabarin
Chairman: F. C. Mock, Director, Fuel Systems Engineering, Bendix Products Division, Bendix Aviation Corporation, South Bend, Indiana

1) "Jet Engine Fuel Pumps." J. A. Lauck, Vice-President, Engineering, Pesco Products Division, Borg Warner Corporation, Bedford, Ohio

*John R. English*
*The Denison Engineering Co.*

*Lee H. Schmohl*
*The Parker Appliance Co.*

*Clarence Johnson*
*Consultant Engineer*

*H. E. Churchill*
*Studebaker Corporation*

2) "Design for Increased Reliability of Aircraft Hydraulic Systems." L. M. Chattler, Bureau of Aeronautics, Navy Department, Washington, D. C.

Panel Members: John Murray, Thompson Products, Cleveland, Ohio; C. L. Sadler, Chief Engineer, Sundstrand Machine Tool Co., Rockford, Illinois

HYDRO POWER: Crystal Room

Chairman: C. J. McLean, General Hydraulic Engineer, Public Service Company of Northern Illinois, Chicago, Illinois

1) "Anti-Racing Hydro-Brake for Adjustable Blade Propellers and Propeller Turbines." P. W. Seewer, Consulting Engineer, The English Electric Company, Limited, London, England
2) "Hydraulically Operated Intake Gates, McNary Dam Powerhouse." R. G. Neighorn, Hydro-Electric Design Branch, North Pacific Division, Corps of Engineers, Portland, Oregon

Panel Member: R. E. B. Sharp, Consultant, S. Morgan Smith Co., York, Pennsylvania

12:30 P.M. LUNCHEON SESSION: Bal Tabarin

Chairman: W. A. Lewis, Dean, Graduate School, Illinois Institute of Technology, Chicago, Illinois

Speaker: Dr. J. T. Rettaliata, President, Illinois Institute of Technology, Chicago, Illinois. "Cooperating with Industry."

2:00 P.M. AFTERNOON TECHNICAL SESSIONS

HYDRAULIC PRESSES: Bal Tabarin

Chairman: R. J. Lindsey, Chief Engineer, American Steel Foundries, Elmes Engineering Division, Cincinnati, Ohio

1) "Control of Large Direct Hydraulic Presses." Frank H. Towler, Towler Brothers, Limited, Rodley, England
2) "Double Action Hydraulic Press Circuits." P. J. Lindner, Chief Engineer, and W. H. Bennett, Asst. Sales Manager, Hydraulic Press Manufacturing Co., Mt. Gilead, Ohio

Panel Members: A. J. deMatteo, Chief Engineer, The Watson-Stillman Company, Roselle, New Jersey; A. Zeitlin, Assistant to the President, Hydropress, Inc., New York, New York

TRACTIVE EQUIPMENT AND MATERIAL HANDLING: Crystal Room

Chairman: J. B. Butler, Professor, University of Missouri School of Mines, Rolla, Missouri

1) "17 Ton Payload Concrete Hauling Unit Having Hydraulically Powered Tractive Effort and Hydraulic Mixing." J. Foster Oury, President, Imperial Construction Equipment Company, Division of Imperial Ready-Mix Concrete Company, Melrose Park, Illinois
2) "Hydraulics of Tracto Loaders for Mining." J. J. Slomer and M. G. Carlson, Goodman Manufacturing Company, Chicago, Illinois

Panel Members: Gerald Carter, Special Engineer, Chain Belt Company, Milwaukee, Wisconsin; D. P. Graham, Design Engineer, Mining Division, Cardox Corporation, 307 N. Michigan, Chicago, Illinois

ACCESSORIES: Old Chicago Room

Chairman: Carl E. Schmitz, Vice-President, Crane Packing Company, Chicago, Ill.

1) "The Surface Type Seal—For Tougher Jobs." R. O. Isenbarger, Chief Engineer, Chicago Rawhide Manufacturing Company, Chicago, Illinois
2) "Tube & Tube Fittings." Lee H. Schmohl, Staff Engineer, The Parker Appliance Company, Cleveland, Ohio
"Portable Tube-Working Tools." George Franck, Executive Chief Engineer, Imperial Brass Manufacturing Company, Chicago, Illinois

Panel Members: To be announced

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# Centennial of Engineering

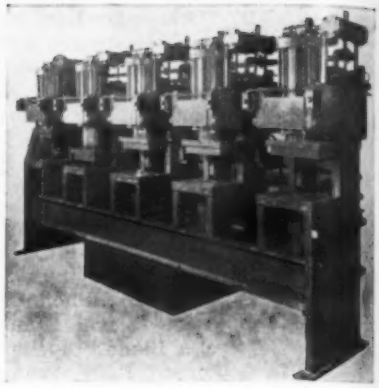
The Centennial of Engineering is a convocation of 61 engineering and technical societies that will be held in Chicago during the period of September 3-13, to mark the 100th anniversary of the founding of the American Society of Civil Engineers. Practically every national engineering society will participate with regular annual meetings or special meetings during this period.

In addition to individual society meetings there will be a series of general or symposium meetings on the general theme "Evaluation of Engineering Progress and its Contribution to the Advancement of Civilization". A second feature will be industrial displays, many of them installed new, at Chicago's Museum of Science and Industry. A third feature will be a dramatic stage production, "Adam to Atom", which will depict outstanding episodes in our industrial growth.

Governor Adlai E. Stevenson of Illinois has issued a proclamation setting apart the period July 12 to September 15 to commemorate the Centennial of Engineering. One or more of the activities of the Centennial will be held during this period.

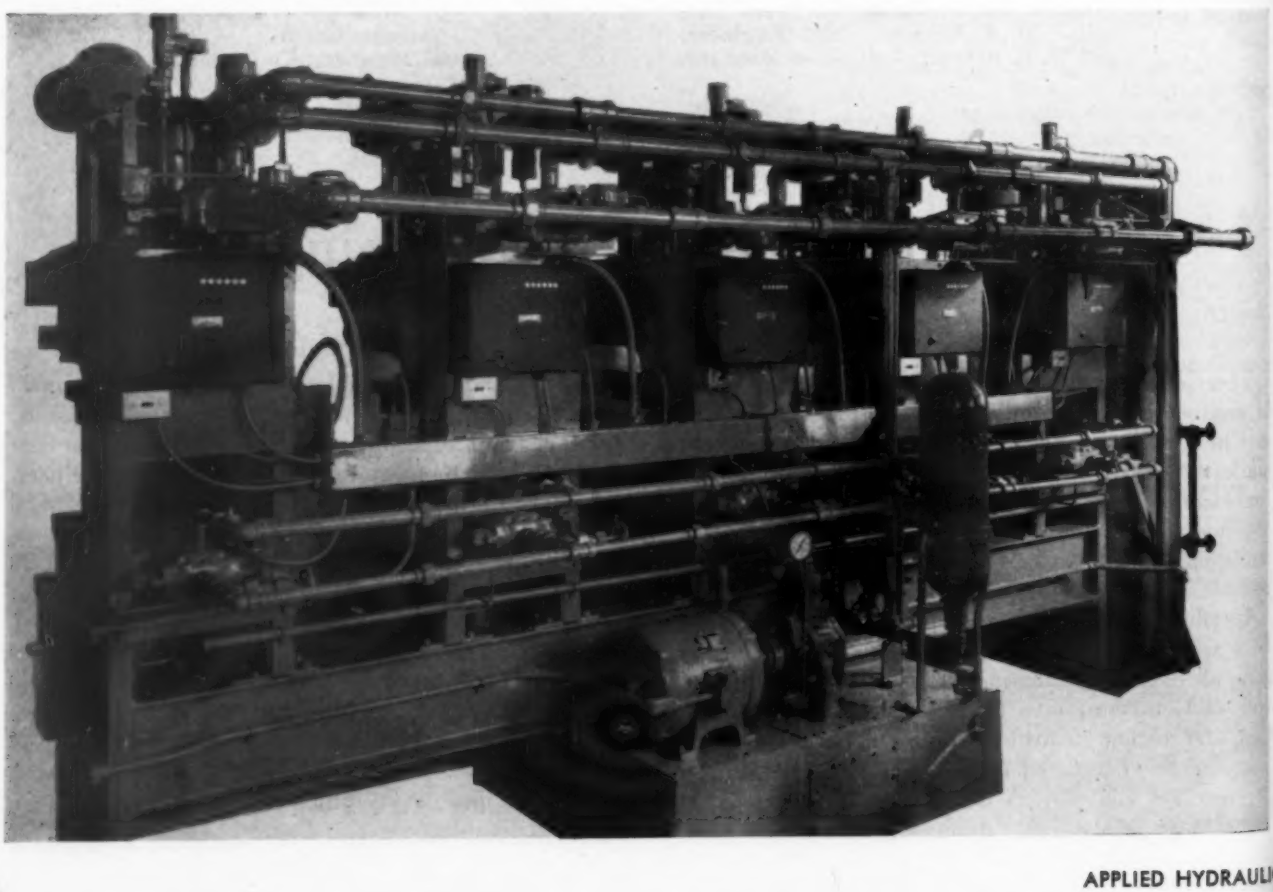
The Centennial meetings will be international in character since many international societies and at least 15 foreign nations will be officially represented. Delegations from free Europe, South America and the Far East (India, Nationalist China and India) will attend. In addition the Mutual Security organization will bring a special mission of 200 leading European engineers to the Centennial as a part of a five-week inspection tour during which they will study American production methods.

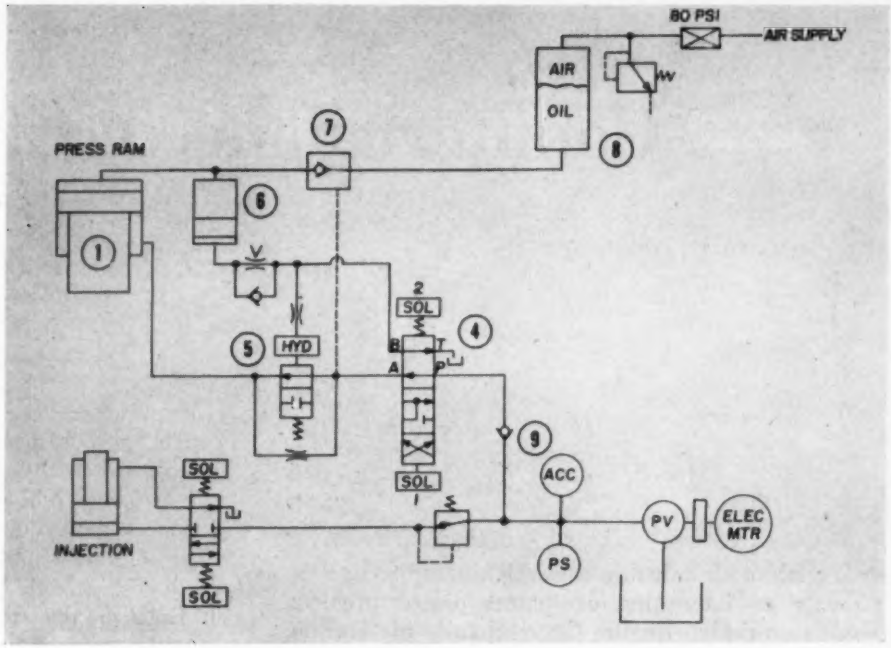
*After you've sketched out the requirements for a special machine do you then look for a "standard" power circuit? If you do, you're probably not getting the simplest and best circuit for your job. While you may have to modify some standard components, you'll often find that you can. . . .*



# Simplify Circuits Where There Are Limited Specs

**POWER FOR** squeezing is supplied by the 12 gpm pump and 5 gallon accumulator. Oil for rapid approach is delivered by the prefill tank seen at the right end of the battery. Air pressure at 80 psi is applied to the top of the prefill tank. Each press has individual electrical bump control panel and hydraulic control valves.






SCHEMATIC of press circuit shows the modified directional valve (4), pilot check (7), special shut off valve (5) and shot cylinder (6) which control the ram travel.

DESIGN of a battery of five rubber molding presses, built by Ferriot Brothers. Akron, includes an unusual hydraulic circuit for providing rapid approach and return, slow squeeze and bumping. The limited operating requirements make possible an efficient hydraulic system with a minimum number of valves and a small power unit.

Oil for rapid advance of all five rams is supplied by 80 psi air pressure acting on oil in a large cylindrical tank. The squeeze and bumping is supplied by individual "shot cylinders" at each ram. A modified three position, 4-way valve, a pilot check and a special cut-off valve control the action of each press ram.

## *One Operator for Five Presses*

Original specifications called for five presses in a battery to be attended by a single operator. The curing time for each press was to be not less than six minutes with the probable closed time eight to ten minutes. A maximum total closing force of 35 tons is also specified. Ram travel of 8 inches was required but no maximum fast traverse closing or opening speed was established. These were to be " as fast as possible".

Provision was to be made for a reduction in closing speed to an adjustable slow speed approximately ¼ inch from the closed position. "Bumping" control was also specified with control of the number of bumps as well as the amount or magnitude of the bump.

Ferriot has built a standard line of rubber presses for many years and decided to adapt as much as possible from the existing design. A press with a 10 inch diameter cylinder and 8 inch diameter rod or ram was used as a base unit.

Because one operator was to control five presses, only one press at a time would open or close. Therefore, a common hydraulic power source for all presses was decided upon. It was also evident that the most efficient system would take full advantage of the minimum interval of six minutes between each repeated press operation. This time interval makes practical the use of an accumulator to cut down the required pump size and reduce power input.

A system, as shown in the diagram, was worked out to meet the operating specifications and to obtain the maximum efficiency from the hydraulic equipment.

Illustrating the economy of the power unit, one 12 gpm, solenoid controlled, dual governor vane pump used on this battery is actually large enough to accomodate an additional battery of five presses, to be added at a future date, based on the same closed or curing time.

This small power unit is made possible by the use of the air-over-oil tank. Referring to the diagram, this tank (8) stores a volume of oil which is more than sufficient to close all five presses. The oil is under an air pressure of 80 psi.

## *Valve Modified to Shift to Extreme Position*

Double solenoid 4-way valve (4) was modified so that with both solenoids deenergized the valve spool is shifted by a spring to an extreme position rather than the conventional center position. With this arrangement, when the press is idle, but with pump running, the neutral valve position has ports P open to A and B to T. The press ram is kept from dropping by oil pressure from the pump or 5 gallon accumu-

Concluded on page 154

# Counterbalanced Circuit

## for safe operation of moving cylinders

By R. T. Todd

UNCOILING a roll of 3/16 inch thick steel, having a width of 93 inches and weighing up to 10 tons, presents an interesting equipment design problem. You can quickly visualize the mechanics of "starting the peel" by considering the simple but often frustrating task of starting a roll of Scotch tape.

Coil peelers built at the The McKay Machine Company, of Youngstown, are used in steel mills at the beginning of pickling and shearing lines. The peeler illustrated in this article is installed in 93 inch shear line built by the Wean Engineering Company, Inc. for Great Lakes Steel Corporation of Ecourse, Michigan.

Coils are brought to the peeler on a V type roller conveyor. Figure 1 shows the end of the conveyor which can be tilted to permit the coil to roll on an inclined ramp until it stops on the rolls of a hydraulic cradle car. A 5 inch diameter, 78 inch stroke cylinder moves the track mounted cradle car between the peeler and processing uncoiler. The coil is first loaded on the cradle car directly under the peeler as seen in Figure 1. Rolls on the cradle car are electrically driven to permit jogging the coil into position under the peeler blade.

Hydraulic circuit design for the peeler is shown in Figure 3. A double pump having a combined volume of 45 gpm is powered by a 20 hp motor. When clamping pressure builds up to approximately 250 psi, the large 35 gpm stage unloads. All peeler operations are controlled by the five manual valves at the operator's station at the side of the peeler, Figure 1.

Assuming the coil is on the cradle car and has been peeled open ready to move into position to load on the mandrel of the processing uncoiler, the operation of hydraulic valves would be as follows. Operation of the lever operated four-way valve (1) will admit

R. T. TODD, Chief Engineer, The McKay Machine Company, Youngstown, Ohio

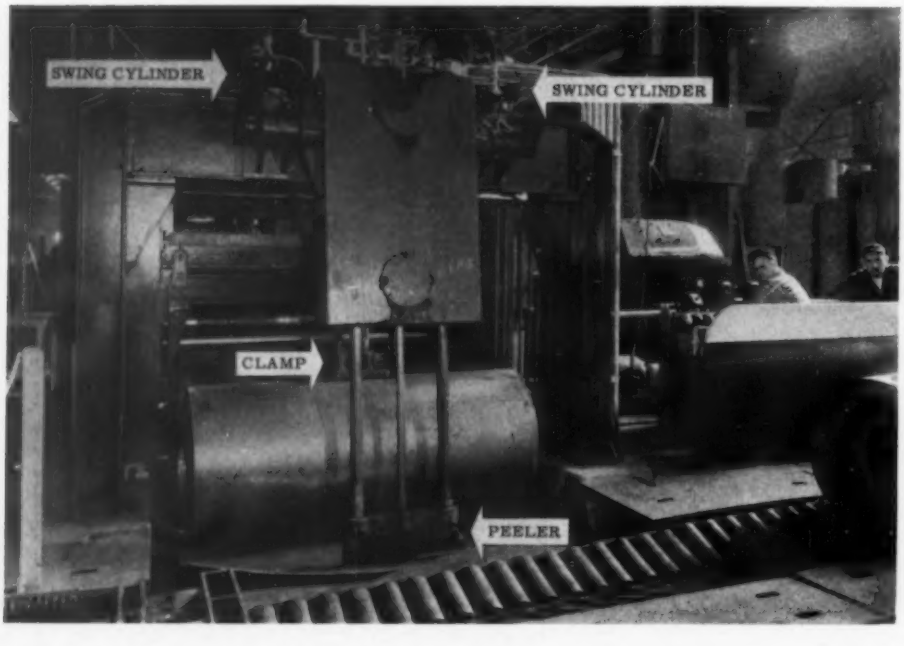



**FIG. 1. FRONT VIEW** of the peeler shows the V type roller conveyor which brings the coils into position. The chisel is positioned by two swing cylinders and a vertical double acting cylinder. A cradle car in a pit below the floor level, is traversed on tracks by a hydraulic cylinder to carry the coil from the peeler to the processing uncoiler.

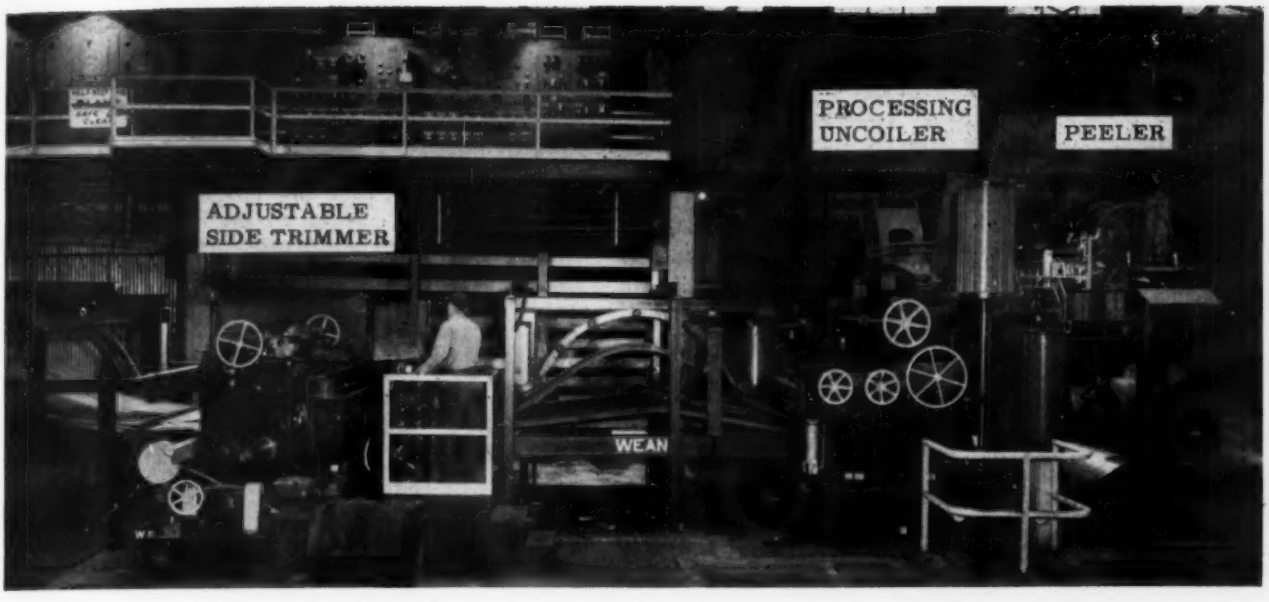



**FIG. 2. THIS WEAN** flying shear line has a McKay peeler at the entry end. A coil, ready for peeling, is in position on the cradle car under the coil clamp. The previous coil, mounted on the mandrel of the processing uncoiler is being uncoiled and fed at a maximum speed of 300 fpm through a hump table loop into the adjustable side trimmer.

oil to the blank end of the traverse cylinder to position the cradle car under the mandrel. At this time oil from the rod end of the cylinder is forced back into the pressure line. This additional volume will increase the speed of the traverse piston. The single acting cradle lift cylinder may be lowered at the same time by operation of operating valve (2) controlling this cylinder. When in position for unloading the coil on the mandrel, the cradle is adjusted up or down by this valve, oil being locked in the cylinder to prevent falling due to the weight of the load when the valve handle is in a center position. Overtravel in the upward position is limited by the cam operated, two-way valve which would be tripped open to dump oil back to tank. The cradle car is returned to loading position by operation of the same valves, 1 and 2, to receive a new coil ready for opening.

The peeler clamp cylinder is operated by a four-way lever operated valve (3). Pressure is maintained on the clamp cylinder unloading through an adjustable relief valve. An accumulator is provided to maintain

Concluded on page 108

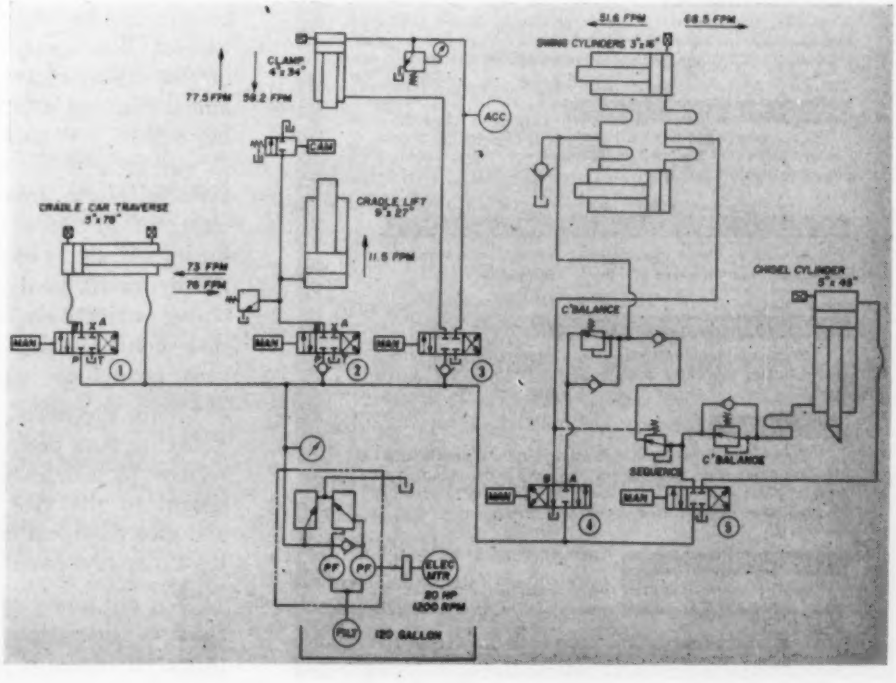
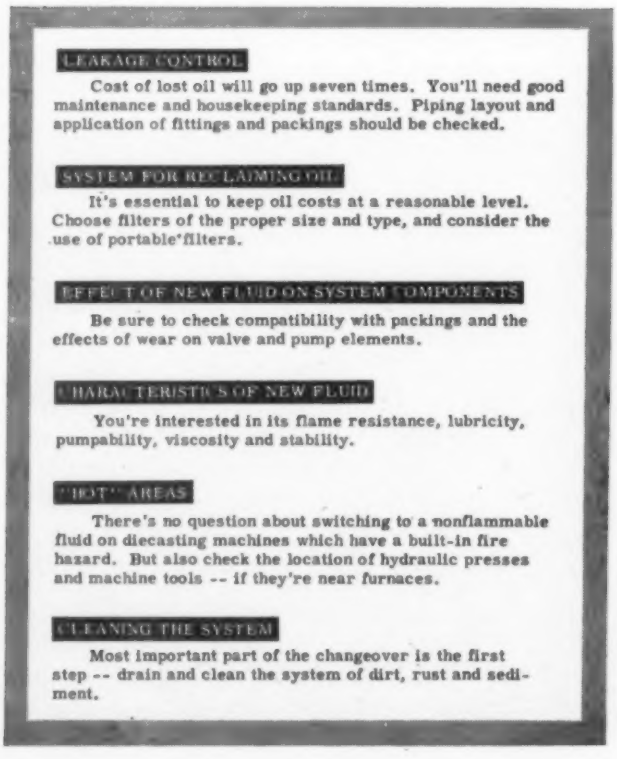



**FIG. 3. CYLINDERS** on this peeler circuit traverse the cradle car, raise and clamp the coil, and position and power the chisel.

*Some industries that use hydraulic fluids in or near "hot" machines are studying the possibility of replacing petroleum base fluids with recently developed nonflammables. If you are planning a changeover, you'll find that most of these new fluids cost much more than petroleum base fluids, which means that more than ever before, you'll need an effective leakage control and oil reclaiming program.*

# How a Die Caster Me H

**If your plant is considering a changeover to nonflammable fluid here are some points you should check:**


LEAKAGE CONTROL
Cost of lost oil will go up seven times. You'll need good maintenance and housekeeping standards. Piping layout and application of fittings and packings should be checked.
SYSTEM FOR RECLAIMING OIL
It's essential to keep oil costs at a reasonable level. Choose filters of the proper size and type, and consider the use of portable filters.
EFFECT OF NEW FLUID ON SYSTEM COMPONENTS
Be sure to check compatibility with packings and the effects of wear on valve and pump elements.
CHARACTERISTICS OF NEW FLUID
You're interested in its flame resistance, lubricity, pumpability, viscosity and stability.
"HOT" AREAS
There's no question about switching to a nonflammable fluid on diecasting machines which have a built-in fire hazard. But also check the location of hydraulic presses and machine tools -- if they're near furnaces.
CLEANING THE SYSTEM
Most important part of the changeover is the first step -- drain and clean the system of dirt, rust and sediment.

THE die casting department of Johnson Motors, manufacturer of the famous "Sea-Horse" outboard motors, is a key unit in the company's integrated facilities at Waukegan, Ill. The department, one of the largest die casting establishments in the middle west and the largest captive plant in the country, produces more than 400 aluminum alloy die castings ranging in size from a ½ ounce control knob to a 11 pound cylinder block. Johnson management, always on the alert for means of improving the department's efficiency and safety as well as lowering real costs, analyed the hydraulic fluid situation in their die casting machines objectively and impartially and determined that nonflammable hydraulic fluids were, in their case, good basic economy.

"While the initial cost of nonflammable fluids today is higher than petroleum-base fluids, we feel costs are relative to benefits obtained," says J. L. Rayniak, assistant to the vice president and general manager, and vice president of Outboard Marine & Manufacturing Company, parent organiation.

"We are going to nonflammable fluid because our chief consideration is the safety of our people and property. A major fire in the die casting department,

**THE DIE CASTING** department at Johnson Motors, a key unit in the integrated facilities at Waukegan, Ill., is housed in a recently constructed building. It utilizes 40 die casting machines to produce more than 400 aluminum alloy die castings, ranging in weight from ½ ounce to 11 pounds, for the famous Sea-Horse series of outboard motors.

# His Fluid Cost Problems

upon which four plants depend, will stop all production. Minor fires are a demoralizing nuisance which also result in costly interruptions.

"In addition, as this type of fluid becomes more prevalent in use, it is to be expected that actuarial findings in reference to fire losses will improve and insurance rates would have a tendency to decline throughout the industry. In the meantime, recent disastrous fires in several plants may have increased our insurance rates if we were not using a nonflammable fluid."

### *Forty Machines in Operation*

Operating conditions of the machines at Johnson are about average. To keep production in the four Johnson plants at capacity 40 package die casting machines are operated on a staggered three shift basis. The systems are operated at pressures up to 2000 psi, with average total die forces in the neighborhood of 300 to 500 tons. Metal brought from meltdown to holding pots (capacity 400 pounds) is cast at temperatures between 1100 and 1200 F. Individual casting temperatures are held to plus or minus 2 F by pyrometer controls. Fluid temperature is maintained between 105 and 110 F by thermostatically controlled water coolers. Die temperatures are approimately 400 F.

A number of nonflammable hydraulic fluids have recently been introduced by various manufacturers. Johnson settled on and is using Pydraul F-9 throughout the shop. Since September 1951, twenty-three of the department's Lester-Phoenix machines have been converted to nonflammable fluids, concurrent with the installation of swivel type joints. The remaining machines are being systematically converted.

Actually "converted" is a misnomer, since the procedure employed in the changeover is simple and requires no modifications or alterations. First, the machine's complete hydraulic system—tanks, cylinders, lines and pumps—is drained and cleaned of dirt, rust and sediment. Then the system is quickly and easily charged with fluid by funneling directly into the tank from drums brought into position on a fork-lift truck.

Because Pydraul's solvent action will loosen and remove accumulated carbon and other deterioration products of petroleum-base fluids, the system is operated for 48 hours (about 32 hours actual working time) with a bag type filter. At the rate of 7 gpm, the

**IN CONVERTiNG** die casting machines at Johnson Motors to a nonflammable type hydraulic fluid, the system is simply drained and thoroughly cleaned before charging with the fluid directly from 55 gallon drum brought into position on fork lift truck. The machine is operated for 48 hours with a bag type filter to remove petroleum base fluid deterioration products loosened by the nonflammable fluid's solvent action.

**DIE CASTING MACHINES** at Johnson Motors are being converted to nonflammable fluid simultaneous with the installation of swivel joints, one of several fluid conservation measures employed at Johnson, which in four years have reduced new fluid requirements from 40,000 gallons to 5,000 gallons per year.

135 gallons of fluid are filtered about 100 times. In addition, and a standard practice at Johnson, the portable filters are connected at least once a month for a 24 hour period.

An outstanding achievement of the Johnson die casting department, due to high maintenance and housekeeping standards established over recent years, is a remarkably low fluid replacement. This is an important factor at any time, but particularly when using a more expensive fluid (approximately $3.75 per gallon as compared to $.50 for petroleum base).

In four years new oil requirements have been reduced from 40,000 gallons a year to about 5,000 gallons, even though during that period the number of machines has increased from 25 to the present 40. Total fluid loss per machine day averages about 2/3 gallon. Since half this loss is made up by reclaimed fluid, the new oil requirement per machine day is only 1/3 gallon. There are several reasons for this achievement.

Maintenance has been improved by the establishment of a rigid program of preventive procedure and higher standards of workmanship, plus the addition of competent personnel as required by the growing work-load.

Johnson was among the first to adopt quick couplers which it modified to withstand high velocity fluid. As a result, fluid loss from core-pull cylinders when changing dies, formerly one to three gallons, has been reduced to a negligible amount.

Swivel joints, now in the process of being installed on all adaptable machines, have helped reduce fluid losses and have cut setting-up costs. In contrast to former loss of from one to three gallons in repositioning bolted lines, swivel joints permit resetting of table level with virtually no fluid loss. The operation which required the time of two men for an hour now can be performed in about 15 minutes by one man.

## *Fluid Reclaiming Section*

Perhaps the biggest economy has come from the establishment four years ago of a fluid reclaiming section. Drained fluid is run through a bag-type filter coated with "Celite" to remove all solids. After pasteurization at 185 F and cooling (to condense and remove moisture) the fluid is pumped into final settling tanks for 24 hours. The fluid is then ready to reuse. The fluid is reclaimed by filtering either with a Fuller's earth or a micronic type filter.

While Johnson has been pleased with Pydraul's performance, there have been problems. Chief disadvantage is that it may cause some swelling in some types of gaskets and packings. The amount of softening and swelling is indicated by immersion tests made at Johnson. "V" type neoprene seals for core-pull cylinders, with a normal durometer reading of 85, dropped to 70 after 90 days immersion. Seals of pre-fill cylinders, which had hardened to 85 after three years of operation in petroleum-base fluids, softened to 60. Normal hardness for this type is 70. Vellumoid paper gaskets show some permeation of fluid, but no leakage.

For these reasons, it is impossible to reinstall standard packings removed from a Pydraul operated system. Unless the machine is dismantled, however, such swelling is not objectionable. Normal practice, followed at Johnson, is to replace packings and gaskets before reassembly. Packing materials resistant to this fluid are available from several manufacturers.

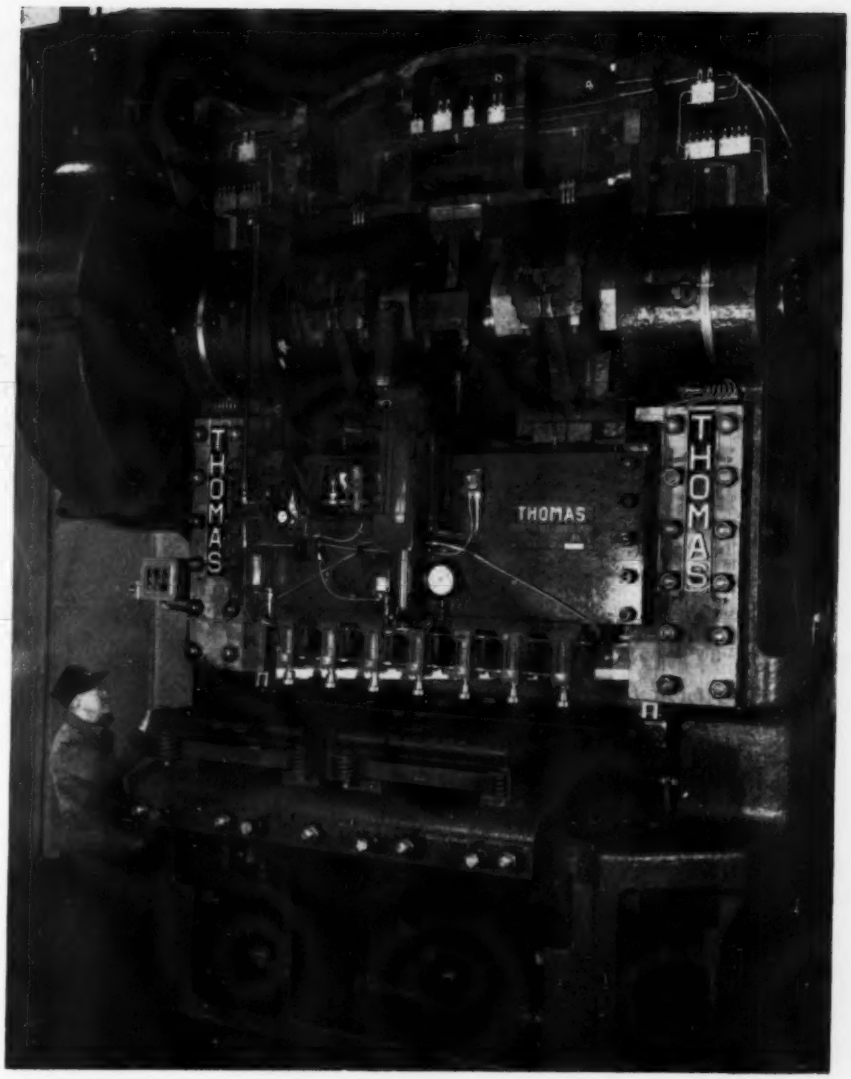



FIG. 1. FRONT of the 1¼ inch stainless steel shear showing the seven holddown cylinders, double acting air-hydraulic booster and control components. The entire holddown circuit including filter-lubricator, solenoid valves, pressures switches, pressure gauge, junction box and control panel are conveniently mounted on the front cover plate.

# Booster Actuated Holddown Cuts Shearing Costs

**How a fabricator of stainless steel plate installed a heavy duty shear using a booster actuated holddown which operates at a fraction of the cost of direct air power with the advantages of high pressure oil power.**

A heavy duty shear for cutting 1¼ inch stainless steel plate, (120,000 psi, shearing strength) made by Thomas Machine Manufacturing Co., Pittsburgh, and installed last April in the plant of Eastern Stainless Steel Co. at Baltimore, Md., incorporates an air-hydraulic booster for a holddown and uses the air side of the same circuit to actuate a clutch cylinder, gauge cylinders and counterbalance cylinders. Previously, Eastern had shipped their plate out of state to be cut. It is expected that the savings over the contract shearing, plus shipping charges, will more than pay for the shear in the first year of operation.

The shear, representative of the custom mill equipment made by the Thomas company, was standard as far as its main frame and operation of the shear blade was concerned. The Eastern plant wanted a fast cycle machine, one that was simple and easy to operate and maintain. Because their monthly contract shearing cost

was quite formidable, they wanted early delivery of the machine.

The Eastern shop had an adequate air supply and men well trained to take care of air systems. Air clutches and counterbalance air cylinders were already represented in other equipment. The problem was to provide a reliable and rugged holddown, if possible integral with the air circuits for operation of the clutch cylinder, the counterbalance and the gauge bar cylinders.

The problem was solved by utilizing an air to hydraulic, double acting booster for high pressure oil operation of the holddown cylinders and the air side of the same circuit for operating the other cylinders.

A double acting booster, giving a dual pressure system, was chosen because it is the most economical in the use of air, the booster saving up to 95 percent of the air that would be consumed in operating with direct air power. This economy also permitted the same circuit to be used for direct air applications, i.e., clutch, counterbalance and gauge bar cylinders. It also meant that a smaller booster could be used; in this case, mounted on the front cross plate of the shear with other components of the circuit. This type of mounting gave the maximum accessibility to valves, pressure switches, filter lubricator unit and the electric junction box (Figure 1).

All operations are manually actuated by depressing push buttons on the control panel.

Air enters the booster through a 4-way solenoid valve when the "down" push button is depressed, sending low pressure oil to the holddown cylinders. When this pressure builds up to air line pressure, the low pressure switch closes. This action operates the 3-way solenoid valve, sending high pressure oil to the holddown cylinders and closing the high pressure switch. Closing the high pressure switch permits operation of the 4-way valve in the run circuit. There are seven holddown cylinders on the shear.

The clutch cylinder is controlled by a 4-way solenoid valve in a branch line of the air supply. Pressure regulators are installed in both supply and return port connections to assure smooth operation.

The two counterbalance cylinders are also supplied off the same shop air line. A surge tank in this line behind a check valve and a pressure regulator maintain an even pressure in the cylinders.

A gauge table on the rear of the machine (Figure 2) controls the travel of the stock between cuts. This travel, and therefore, the width of each sheared piece, is predetermined and set by screws operating a traveling gauge bar. Limit switches on the gauge table stop the gauge bar at extreme ends of travel.

## *Prevent Binding of Work*

Two gauge cylinders operated by solenoid valves retract the gauge bar a small distance after the material has been clamped under the holddown cylinders. This prevents the sheared piece from binding between the gauge bar and shear knives. The carriage slide is actuated by a gear and chain drive arrangement from a separate geared motor. The shear clutch can not be operated unless the gauge bar has been retracted.

The sequence of operation is controlled manually. The cycle of operation is started by depressing the "down" push button. This opens the 4-way solenoid

**FIG 2. THE REAR** of the press showing the gauge carriage, with the chain drive from geared motor. Gauge bar cyinders are seen at the sides of the carriage. The surge tank and shear drive motor are mounted above the main frame.

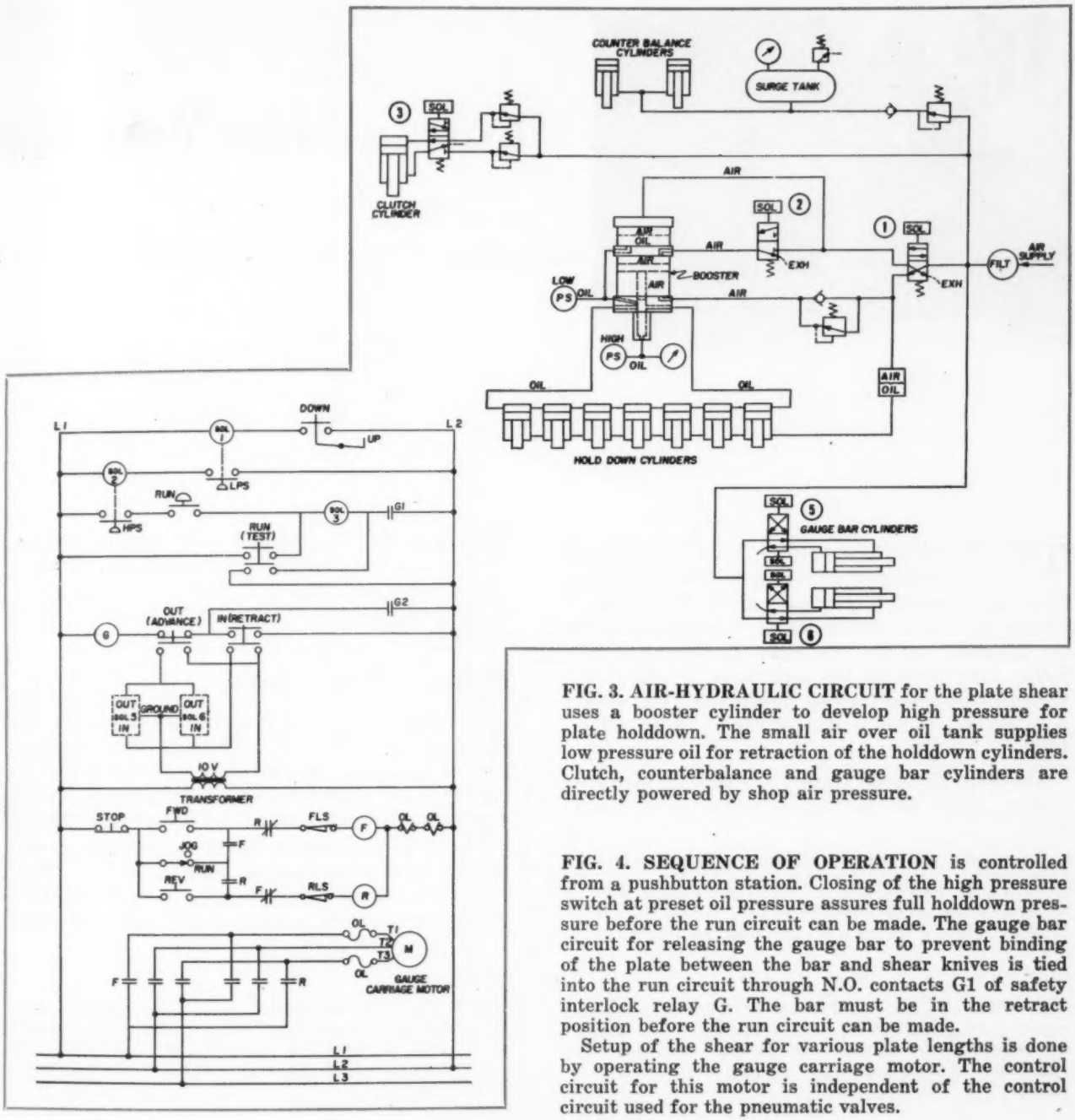



**FIG. 3. AIR-HYDRAULIC CIRCUIT** for the plate shear uses a booster cylinder to develop high pressure for plate holddown. The small air over oil tank supplies low pressure oil for retraction of the holddown cylinders. Clutch, counterbalance and gauge bar cylinders are directly powered by shop air pressure.

**FIG. 4. SEQUENCE OF OPERATION** is controlled from a pushbutton station. Closing of the high pressure switch at preset oil pressure assures full holddown pressure before the run circuit can be made. The gauge bar circuit for releasing the gauge bar to prevent binding of the plate between the bar and shear knives is tied into the run circuit through N.O. contacts G1 of safety interlock relay G. The bar must be in the retract position before the run circuit can be made.

Setup of the shear for various plate lengths is done by operating the gauge carriage motor. The control circuit for this motor is independent of the control circuit used for the pneumatic valves.

valve to the upper air side of the booster. The low pressure switch closes and energizes the 3-way solenoid valve, forcing high pressure oil into the holddown cylinders and closing the high pressure switch in the run circuit.

The gauge bar is then retracted by depressing the "in" push button. This reverses (through relay G) the two gauge cylinder solenoid valves, moving the gauge cylinders and retracting the gauge bar.

The shear cut is then made by depressing the "run" push button. This deenergizes the clutch solenoid valve, operating the shear.

Then the booster cycle is reversed by depressing the "up" push button. The 4-way solenoid valve opens and the high pressure oil reverses flow to the upper oil storage chamber in the booster. An auxiliary air-oil tank, the oil side of which is connected to the rod end of the holddown cylinders and the air side to the lower air chamber of the booster, acts as a surge tank to assure smooth movement of the holddown cylinders.

The "out" button is then depressed, advancing the gauge bar for the next cut. The shear is then ready for the next cycle.

The shear may be operated alone, without holddown or gauge bar movements, by depressing the "test" button, a cylinder lock button, offset from the control panel. A "jog-run" button may be used for setup purposes for forward or reverse jogging of the gauge bar.

The use of the dual pressure booster made it possible to operate high pressure oil cylinders for holddown off of shop air; the most economical operation is assured; and the entire circuit is simple, rugged and easily maintained. Production-wise, the shear will pay for its original cost in the first 12 months of operation.

# Do You Have a

THE "Runabout", a vertical boom, high speed ditcher, developed and built by Barber-Greene Company, Aurora, Ill., incorporates hydraulic operation of two basic features of the machine to enable the equipment to open and refill ditches up to 10½ inches wide and four feet deep faster and better coordinated than was possible previously. The ditcher is in use by utilities in the installation of home services.

The vertical boom carries a chain of cast steel buckets which run at variable speeds in a vertical plane.

Originally the proper relation or ratio between bucket line speeds and forward speeds, using a series of mechanical gear selections, was a trial and error process, always an unwelcome task to operators of ditching equipment. In addition, the mechanical transmissions limited the machine to a choice of a few combinations and the usual result was that the most efficient use was not made of the engine horsepower available.

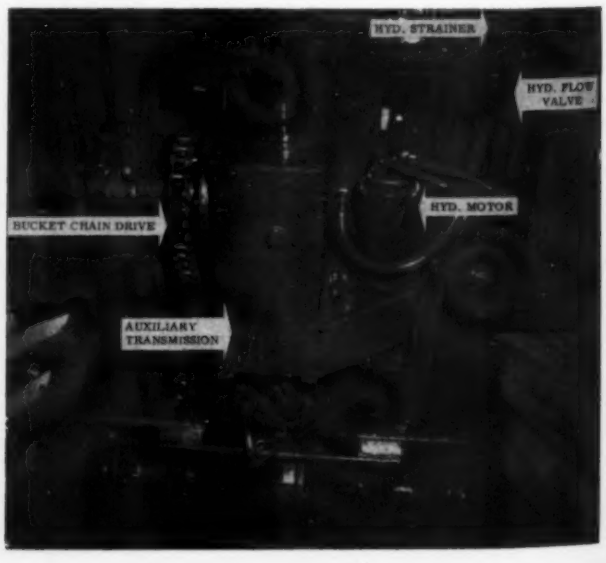
### *Hydraulic Transmission Is Used*

In the changeover to hydraulic operation, the conventional step gear shift difficulties were overcome with a hydraulic transmission, which provided an infinite range of forward speeds, independent of both regular travel speeds and the bucket line speed changes.

The original machine had been designed around the chassis of a commercial, industrial tractor. However, in the design of the new unit, it proved advantageous to utilize a special chassis, plus a standard

**THE TWO LEVER CONTROLS** (left, boom ram lever; right; fluid motor lever) on the vertical boom ditcher are convenient for driver or off the truck operation. The speed control for travel while digging is on the circular plate.

**REAR VIEW** of the ditcher showing hydraulic motor, the auxiliary transmission which it drives, the bucket chain drive flow control valve and strainer. The chain drive is engaged by the tooth clutch. Crowding speed is adjustable.



# Have a Speed Coordination Problem?

## Here's how fluid power solved it on a ditcher

industrial engine and transmission, a differential rear axle unit and a hydraulic drive unit.

The two operations hydraulically controlled are the forward cutting travel and the boom hoist. A front bulldozer blade can be added as special equipment.

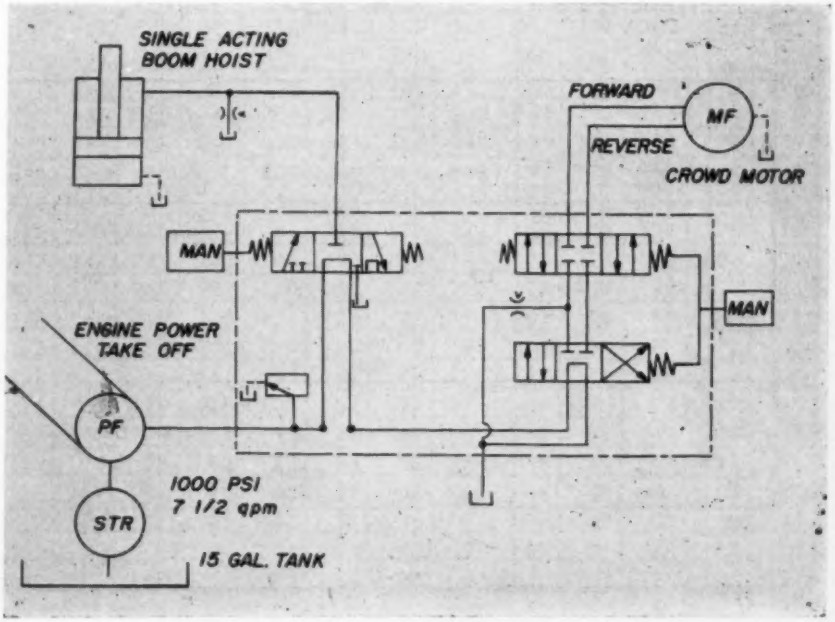
The cutting travel or forward "crowding" of the machine is to travel while the machine is cutting. The hydraulic "crowding" drive, which gives the operator infinitely variable, finger tip control of the forward motion of the machine while digging, is built around a piston-type hydraulic motor which drives an auxiliary transmission. This auxiliary transmission is independent of the master clutch, since the hydraulic pump, which runs continuously, is driven from the engine crankshaft.

The boom hoist, on which the bucket line assembly is mounted, is raised and lowered from the digging operation by means of a single acting ram. The speed at which the boom drops can be regulated by an adjustment screw in the throttling valve located in the tee on the pressure inlet of the ram.

The bucket line is driven by the master clutch through a bucket line clutch, so that three speeds for cutting are available.

Variations in underground conditions require changes in both forward speed and bucket line speed. Some types of soils, especially those which are sticky or tacky, must be approached with a very high bucket line speed and relatively slow forward or "crowding" speed. With these conditions, the earth is shaved off in small quantities, much in the manner of a milling

Continued on page 89




**THE HYDRAULIC CIRCUIT** which drives the fluid motor and operates the boom cylinder. Control valves are housed in one compact unit. Raising the boom cuts off oil to crowd motor. In neutral, both the ram and motor are locked by trapped oil.

# How To Determine Tubing Wall Thickness

**Part 3 of a series on Fluid Lines**

**By R. W. Phillips**

MANY types of tubing are used for industrial applications. We cannot hope to cover all of these in this series. However, an effort will be made to list those most commonly encountered in hydraulic applications.

One of the most frequently asked questions on hydraulic equipment is: "What pressure is the device good for?" Tubing is no exception. Common hydraulic practice calls for a minimum of four to one safety factor. Aircraft tubing is in this category. The JIC Hydraulic Standards for Industrial Equipment calls for five to one safety factor (par H4.2.4) for tubing and hose. In some applications, a ten to one factor may be necessary. For general usage, a five to one safety factor is normaly adequate. Safety factors of less than four to one should be used only when there is a minimum of hard service to be encountered. A lower ratio should never be used when high peak pressures and severe vibration are anticipated.

R. W. PHILLIPS is Project Engineer, Hose and Fittings Division, The Weatherhead Company.

## *Tubing Thickness*

The wall thickness of tubing can be determined quickly from a burst pressure table. Table is taken from a booklet 17-B, published by Reynolds Metals. This table may be used for calculating burst strengths

| | SIZE | Seamless Steel | Welded Steel | Stainless Steel | Alum. | Copper Annealed | Bundy Steel | ER & Ermeto Ring I.D. Min. |
|---|---|---|---|---|---|---|---|---|
| | 2 | +.004<br>-.000 | +.003<br>-.003 | +.005<br>-.005 | +.003<br>-.003 | +.002<br>-.002 | +.001<br>-.001 | .129 |
| | 3 | | | | | | | .190 |
| 1/4 | 4 | | | | | | | .255 |
| | 5 | | | | | | | .318 |
| | 6 | | | | | +.0025<br>-.0025 | | .380 |
| 1/2 | 8 | +.005<br>-.000 | +.004<br>-.004 | | +.004<br>-.004 | | +.000<br>-.005 | .506 |
| | 10 | | +.005<br>-.005 | | | | +.000<br>-.005 | .633 |
| | 12 | | | | | +.003<br>-.003 | | .758 |
| | 14 | | | | | | | .883 |
| 1 | 16 | | | | +.005<br>-.005 | +.0035<br>-.0035 | | 1.008 |
| | 18 | | | | | | | 1.133 |
| | 20 | | | | | +.004<br>-.004 | | 1.260 |
| 1 1/2 | 24 | +.010<br>-.000 | | +.010<br>-.010 | | +.0045<br>-.0045 | | 1.510 |
| | 28 | | | | | | | 1.762 |
| 2 | 32 | | | | +.006<br>-.006 | +.005<br>-.005 | | 2.014 |

TABLE 1. Recognized tolerances for standard tubing diameters in thousandths of an inch. Numbered sizes indicate tube diameters in sixteenths.

Courtesy The Weatherhead Co.

of tubing, based on minimum tensile strengths (in psi) of the materials being used.

The formula is:

$$\text{Burst Pressure} = \text{Tensile Strength} \times \frac{\text{OD}^2 \text{ minus ID}^2}{\text{OD}^2 \text{ plus ID}^2}$$

The table gives the factor $\frac{\text{OD}^2 \text{ minus ID}^2}{\text{OD}^2 \text{ plus ID}^2}$, so that the formula simplifies to:

Burst Pressure = Tensile Strength x Factor

To find the wall thickness for a given tubing application, check the known specifications and requirements. If the tubing to be used is to work at 1500 psi in a ½ inch size, the material is 1010 steel and the safety factor is 5 to 1, the wall thickness can be found by applying the formula:

Burst Pressure = Tensile Strength (in psi) x Factor

or $P_b = S \times \text{Factor}$

in which $P_b = 1500$ psi (working pressure) x 5 (safety factor)

$= 7500$ psi and $S = 55{,}000$ psi (tensile strength, see Table, Figure 3)

Solve for F

$$\frac{P_b}{S} = F = \frac{7500}{55{,}000} = .137$$

Enter Table 2 column ½ OD to nearest wall thickness above 137, we find all thickness of .032. We therefore designate the tubing size as ½ x .032 tubing.

If, in another case we start with a given tubing size and wish to determine whether a pressure is safe to

**TABLE 2. Burst pressure of tubing can be easily computed from the formula, $P_b = S \times$ Constant, where S is the material's tensile strength and the constant for a given size is read from this table.**
Courtesy Reynolds Metal Co.

**ROUND TUBING— $\frac{D^2-d^2}{D^2+d^2}$ (In Thousandths)**

| WALL THICKNESS | | OUTSIDE DIAMETER—Inches | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stubs' Gauge | Inches | ¼ | 5/16 | ⅜ | 7/16 | ½ | 5/8 | ¾ | ⅞ | 1 | 1⅛ | 1¼ | 1⅜ | 1½ | 1⅝ | 1¾ | 1⅞ | 2 |
| | .500 | | | | | | | | | | | | | | | | | |
| | .480 | | | | | | | | | | | | | | | | | |
| | .450 | | | | | | | | | | | | | 724 | 668 | 618 | 574 | 536 |
| | .400 | | | | | | | | | | | | | 642 | 590 | 545 | 505 | 471 |
| | .375 | | | | | | | | | | | | 658 | 600 | 550 | 508 | 471 | 438 |
| | .350 | | | | | | | | | | | | 612 | 557 | 511 | 471 | 436 | 406 |
| | .320 | | | | | | | | | 771 | 687 | 615 | 556 | 505 | 463 | 426 | 395 | 368 |
| 1 | .300 | | | | | | | | 820 | 725 | 652 | 574 | 518 | 471 | 431 | 397 | 368 | 342 |
| 2 | .284 | | | | | | | | 781 | 685 | 606 | 541 | 488 | 443 | 405 | 374 | 346 | 322 |
| 3 | .259 | | | | | | | 825 | 715 | 623 | 549 | 489 | 440 | 400 | 366 | 337 | 313 | 291 |
| 4 | .238 | | | | | | 924 | 764 | 656 | 569 | 501 | 446 | 401 | 364 | 333 | 307 | 285 | 265 |
| 5 | .220 | | | | | | 839 | 708 | 604 | 523 | 459 | 409 | 368 | 334 | 306 | 282 | 261 | 243 |
| 6 | .203 | | | | | | 781 | 652 | 554 | 478 | 420 | 374 | 336 | 306 | 280 | 258 | 239 | 223 |
| 7 | .180 | | | | | 855 | 695 | 574 | 485 | 419 | 368 | 327 | 295 | 268 | 245 | 226 | 210 | 196 |
| 8 | .165 | | | | 886 | 793 | 636 | 523 | 441 | 380 | 334 | 297 | 268 | 243 | 223 | 206 | 191 | 178 |
| 9 | .148 | | | 915 | 811 | 715 | 566 | 464 | 391 | 337 | 296 | 264 | 238 | 216 | 198 | 183 | 170 | 159 |
| 10 | .134 | | 960 | 849 | 739 | 646 | 508 | 415 | 350 | 302 | 266 | 237 | 213 | 194 | 178 | 165 | 153 | 143 |
| 11 | .120 | 997 | 898 | 771 | 661 | 574 | 450 | 368 | 310 | 268 | 235 | 210 | 190 | 172 | 158 | 146 | 136 | 127 |
| 12 | .109 | 968 | 832 | 702 | 598 | 517 | 404 | 331 | 279 | 241 | 212 | 189 | 171 | 156 | 143 | 132 | 123 | 115 |
| 13 | .095 | 891 | 734 | 608 | 515 | 445 | 347 | 284 | 240 | 208 | 183 | 163 | 148 | 135 | 124 | 114 | 106 | 99 |
| 14 | .083 | 797 | 640 | 526 | 444 | 383 | 299 | 245 | 207 | 180 | 158 | 142 | 128 | 117 | 107 | 99 | 92 | 86 |
| 15 | .072 | 695 | 550 | 450 | 379 | 327 | 256 | 210 | 178 | 154 | 136 | 122 | 110 | 101 | 93 | 86 | 80 | 75 |
| 16 | .065 | 625 | 491 | 402 | 339 | 292 | 229 | 188 | 159 | 138 | 122 | 109 | 99 | 90 | 83 | 77 | 72 | 67 |
| 17 | .058 | 554 | 433 | 354 | 299 | 258 | 202 | 166 | 141 | 123 | 108 | 97 | 88 | 80 | 74 | 68 | 64 | 60 |
| 18 | .049 | 460 | 359 | 294 | 248 | 215 | 169 | 139 | 118 | 103 | 91 | 81 | 74 | 67 | 62 | 58 | 54 | 50 |
| 19 | .042 | 388 | 303 | 248 | 210 | 182 | 143 | 118 | 101 | 88 | 77 | 69 | 63 | 58 | 53 | 49 | 46 | 43 |
| 20 | .035 | 317 | 248 | 204 | 173 | 150 | 118 | 98 | 83 | 72 | 64 | 58 | 52 | 48 | 44 | 41 | 38 | 36 |
| 21 | .032 | 287 | 225 | 185 | 157 | 136 | 107 | 89 | 76 | 66 | 59 | 53 | 48 | 44 | 40 | 37 | 35 | 33 |
| 22 | .028 | 248 | 195 | 160 | 136 | 118 | 94 | 77 | 66 | 58 | 51 | 46 | 41 | 38 | 35 | 33 | 30 | 28 |
| 23 | .025 | 219 | 173 | 152 | 121 | 105 | 83 | 69 | 58 | 51 | 45 | 41 | 37 | 34 | 31 | 29 | 27 | 25 |
| 24 | .022 | 191 | 151 | 124 | 106 | 92 | 73 | 60 | 52 | 45 | 40 | 36 | 33 | 30 | 27 | 26 | 24 | 22 |

| | SIZE | 250 | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 2500 | 3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 4 | | | | | | .020 | .020 | .022 | .028 | .035 |
| | 5 | | | | | .020 | .022 | .025 | .028 | .035 | .042 |
| | 6 | | | | .020 | .022 | .025 | .032 | .035 | .042 | .049 |
| | 8 | | | | .025 | .032 | .035 | .042 | .049 | .058 | .065 |
| 1/2 | 10 | | | .022 | .032 | .035 | .042 | .049 | .058 | .072 | .083 |
| | 12 | | | .028 | .035 | .042 | .058 | .065 | .072 | .083 | .100 |
| | 16 | | .025 | .035 | .040 | .058 | .072 | .083 | .095 | .109 | .134 |
| 1 | 20 | | .032 | .049 | .058 | .072 | .095 | .109 | .120 | .148 | .165 |
| | 24 | .022 | .035 | .058 | .072 | .095 | .109 | .120 | .134 | .165 | .203 |
| 2 | 32 | .025 | .049 | .072 | .095 | .109 | .148 | .165 | .180 | .238 | .259 |

Table 3

| | SIZE | 500 | 750 | 1000 | 1250 | 1500 | 2000 | 2500 | 3000 | 4000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 4 | | | | | | | | .022 | .028 |
| | 5 | | | | | | | .022 | .025 | .035 |
| | 6 | | | | | | .022 | .025 | .032 | .042 |
| | 8 | | | | | .022 | .025 | .035 | .042 | .058 |
| 1/2 | 10 | | | .022 | .025 | .028 | .032 | .049 | .058 | .072 |
| | 12 | | | .025 | .028 | .035 | .042 | .058 | .065 | .083 |
| | 16 | | .022 | .032 | .042 | .049 | .058 | .072 | .083 | .120 |
| 1 | 20 | | .032 | .042 | .049 | .058 | .072 | .095 | .109 | .148 |
| | 24 | .022 | .035 | .049 | .058 | .065 | .095 | .109 | .134 | .165 |
| 2 | 32 | .032 | .049 | .058 | .083 | .095 | .120 | .148 | .180 | .220 |

Table 4

| | SIZE | 500 | 750 | 1000 | 1250 | 1500 | 2000 | 2500 | 3000 |
|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 4 | | | | | .022 | .028 | .032 | .042 |
| | 5 | | | | .022 | .025 | .035 | .042 | .049 |
| | 6 | | | .022 | .025 | .032 | .042 | .049 | .058 |
| | 8 | | .022 | .028 | .035 | .042 | .058 | .065 | .083 |
| 1/2 | 10 | .022 | .028 | .032 | .042 | .049 | .065 | .083 | .095 |
| | 12 | .022 | .032 | .042 | .049 | .065 | .083 | .095 | .120 |
| | 16 | .028 | .042 | .058 | .072 | .083 | .109 | .134 | .165 |
| 1 | 20 | .035 | .058 | .065 | .083 | .109 | .134 | .165 | .203 |
| | 24 | .042 | .065 | .083 | .109 | .120 | .165 | .203 | .238 |
| 2 | 32 | .058 | .083 | .109 | .134 | .148 | .203 | .259 | .300 |

Table 5

**TABLE 3. Annealed 1010 Steel Tubing (55,000 psi, tensile) Wall thickness of various OD tubing through a pressure range of 250 to 3000 psi is tabulated allowing a factor of safety of 5.**

**TABLE 4. Annealed Stainless Steel Tubing (80,000 psi tensile) Wall thickness of various OD tubing through a pressure range of 500 to 4000 psi is tabulated allowing a factor of safety of 5.**

**TABLE 5. Aluminum Tubing 61ST (42,000 psi tensile) Wall thickness of various OD tubing through a pressure range of 500 to 3000 psi is tabulated allowing a factor of safety of 5.**

use for a given installation, we can do so readily. For example, we have a ¾ inch x .035 tube of annealed stainless that we want to use on a system operating at 2000 psi. Our safety factor is 4 to 1.

Our formula is then:

$$P_g = \frac{P_b}{F}$$

First find $P_b$. Enter Table 2, we have a factor of .98. Since S = 80 (for 80,000 psi, Table 4), $P_b = 80 \times 98 = 7840$ psi.

$$P_g = \frac{P_b}{F} = \frac{7840}{4} = 1948 \text{ psi.}$$

Since this tube of .035 wall thickness falls short of the operating pressure, choose the next standard wall thickness of .042.

The tubing wall thickness can be directly selected from Table 4.

## *Barlow Formula*

A widely used formula--Barlow Formula—is commonly used to calculate the wall thickness of tubing. This formula is:

$$\text{Thickness in inches} = \frac{\text{OD (inches)} \times \text{Pressure (psi)}}{2 \times \text{Tensile Strength (psi)}} \quad \text{or}$$

$$t = \frac{dP}{2S}, \text{ in which}$$

t = thickness in inches
d = outside diameter in inches
P = minimum burst pressure (psi)
S = tensile strength (psi)

To illustrate: suppose a ½ inch tube is to be used at 1500 psi with a safety factor of 5 to 1. The tubing is annealed 1010 steel with a tensile strength of 55,000 psi.

$$t = \frac{\frac{1}{2} \times 5 \times 1500}{2 \times 55{,}000} = \frac{3750}{110{,}000} = .034 \text{ inches}$$

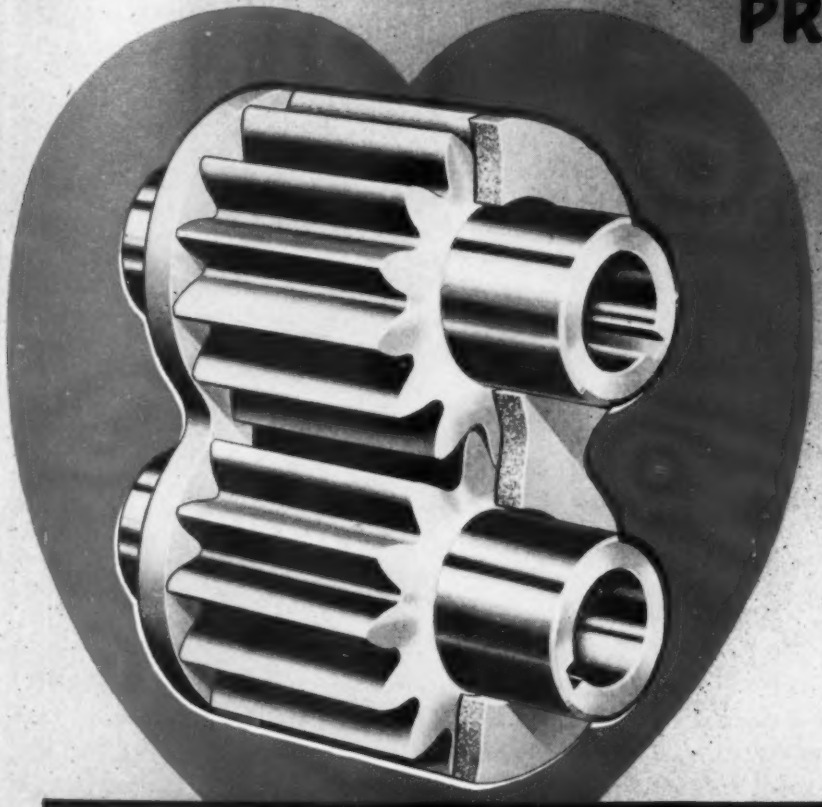
Using the nearest larger size of standard tubing, the .035 wall tubing is selected. Size ½ x .035 wall tubing would be used.

When a sleeve or nut is used with tubing, it is necessary to know what tolerances can be successfully assembled. A table of recognized tolerances for standard tubing is given in Table 1 so that the user can determine whether or not the tubing being held lies within these requirements in case trouble develops.

Tables for various ranges for various kinds of commonly used tubing, based on a 5 to 1 safety factor, are given, Tables 3, 4 and 5. Sizes are listed in sixteenths, as is common with tubing. Tables for three of the most commonly used materials are given.

The tables give the nearest standard wall thicknesses for each pressure listed. In many cases, the wall thicknesses are so great that unless heating is resorted to, flared fittings could not be readily used. Where the wall thicknesses are excessive, a stronger alloy tubing should be used to give the greatest possible flow. The data for heavy walled tubing has been given for comparative reasons so that, should any analysis be made, data would be available in easily accessible form.

# "COMMERCIAL" HYDRAULIC PRODUCTS



**The heart of all "Commercial" Hydraulic Circuits which are power operated by our continuous running pumps—feature . . .**

- Hardened Alloy Steel Gears having specially developed tooth contour—with all surfaces (teeth and faces) ground to extremely close tolerances . . .
- Integral Hubs on the Gears sized for heavy duty roller bearings—thus reducing deflection and wear to a minimum . . .
- Special Non-galling Bronze Alloy Heavy Thrust Plates ground to close thickness tolerance . . .

All to insure a unit that is simple in design—highly efficient in operation—built for long life expectancy at an economical (initial — operating — maintenance) cost for the user.

## THE HEART OF "COMMERCIAL" HYDRAULIC SYSTEMS

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# Aircraft Pneumatic Systems

**Part 2**

## Elements in the System

**By H. R. Haerle**

*Part 1 of Mr. Haerle's article appeared in the August APPLIED HYDRAULICS. Compressor design, cooling and lubrication were discussed along with problems of pressure control.*

### *Storage Bottles*

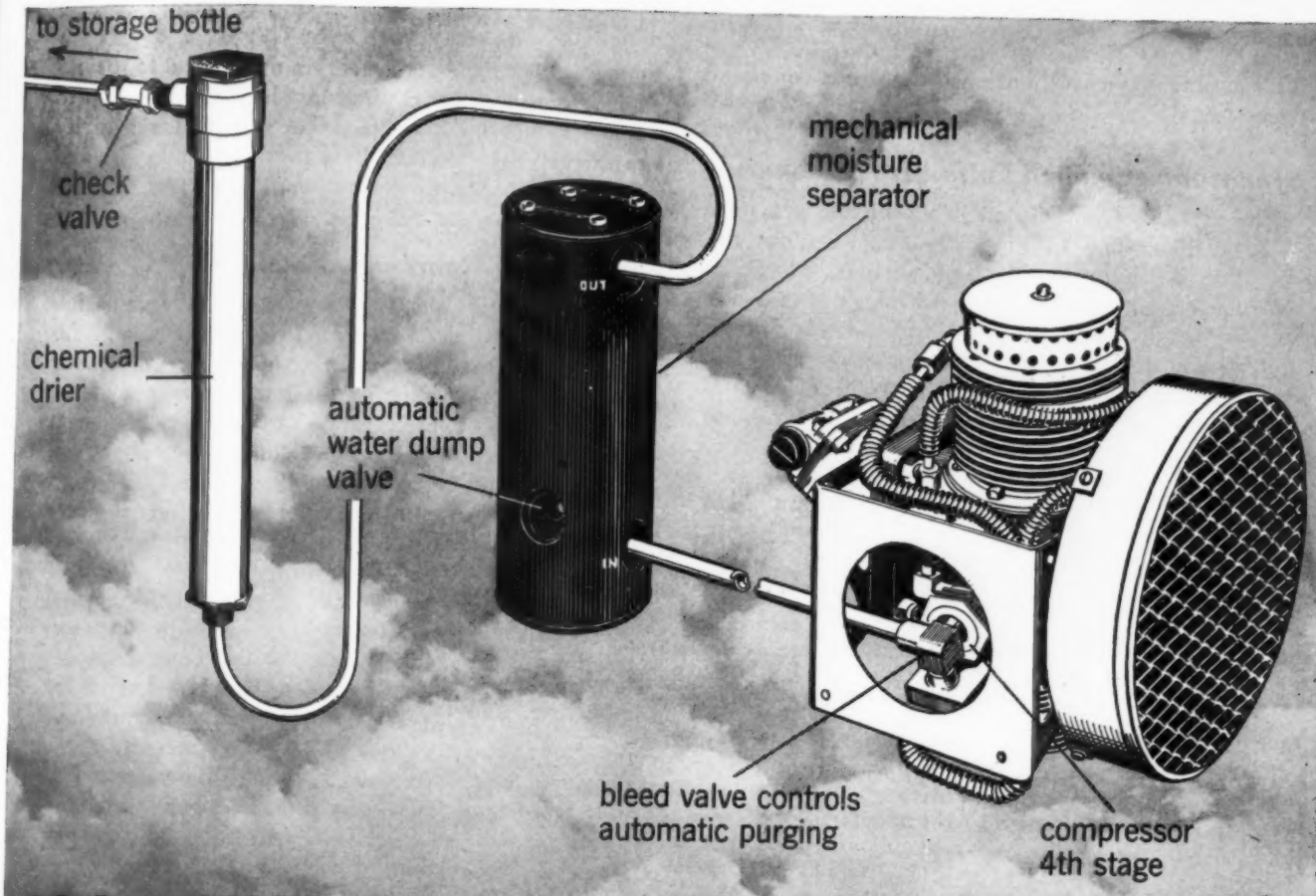
It frequently happens that the largest and heaviest item in a pneumatic system is the air reservoir and for this reason increasing attention is being paid to the evolution of high efficiency bottles. Small systems have in the past used steel, wire wound bottles, similar to oxygen bottles. Production techniques in the light alloy industry have facilitated the evolution of aluminum alloy bottles for military aircraft, where there is a possibility of damage due to shell fire, it has been found desirable to wire wind duralumin bottles. This effectively prevents fragmentation without imposing too severe a weight penalty. Table 1 indicates weights of current bottles. It has been found that although spherical bottles are theoretically the lightest for a given capacity, difficulties of installation, plus the higher weight of the associated mounting mitigate against them. A further disadvantage is their relatively high cost. A fabricated light alloy bottle at present under development weighs 6.25 pounds for a capacity of 234 cu in at 3000 psi.

H. R. HAERLE, Technical Manager, The Hymatic Co., Ltd., Redditch, Worcestershire, England.

### *Relay Valves*

In order to eliminate large high pressure pipework in the cockpit and and also to make operating loads on control valves as small as possible, use is made of relay valves, such as those shown in Figure 6. It will be seen that the cockpit controls are very small; these valves can be used with a variety of relay operated valves placed close to the actuator. Push-button controls may be substituted for the lever shown. By employing air at a low pressure—say 200 psi—large control valves may be rapidly actuated, even when controlling air pressures up to 3000 psi, and the tubing between relay and valve need be no larger than ⅛ inch.

A further advantage of relay valves is that their use permits the storage bottles to be located in close proximity to the service which is being operated, thus reducing pipe losses and also the size and weight of the main pipe system between bottle and actuator. In high speed operation, it is not only the pipe losses on the pressure side which have to be kept small but also those on the exhaust side, as a high back pressure seriously retards the actuator. There are, of course, some services which make use of this back pressure

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for a cushioning effect, but such cases are comparatively few.

### *Synchronization and Follow-Up Mechanism*

The problem of synchronizing pneumatic actuators of large dimensions in which the total time for the operation is of the order of ½ seconds, is a very difficult one, e.g., the lack of synchronization in such services as dive brakes would have serious effects on the stability of the aircraft. Development of suitable equipment is proceeding and it is confidently anticipated that a satisfactory solution will be forthcoming.

| *Capacity cu. in.* | *Working Pressure psi* | *Type* | *Weight in lbs.* |
|---|---|---|---|
| 300 | 600 | Cylindrical | 4.2 |
| 400 | 600 | " | 5.1 |
| 620 | 600 | " | 7.4 |
| 200 | 1000 | " | 4.1 |
| 400 | 1000 | " | 7.1 |
| 45 | 1100 | " | 0.8 |
| 220 | 1100 | " | 6.8 |
| 350 | 1100 | " | 9.5 |
| 1200 | 1100 | " | 17.5 |
| 1200 | 1100 | Spherical | 17.3 |

TABLE 1. Weight of light alloy bottles

Follow-up mechanisms for controlling wing flaps exist already, and on some small craft a follow-up valve provided with a positive mechanical feed-back is operating satisfactorily. An electro-pneumatic follow-up mechanism which is simple and reliable is shown diagrammatically in Figure 7. This gives sixteen positions for the ram, the follow-up control being almost instantaneous. The design of the equipment permits the degree of sensibility to the greatest around the take-off and landing positions.

The cockpit control is by the conventional lever which is connected to the rheostat head; any degree of friction or resistance to movement can be built-in to the lever boss by the aircraft designer. The position monitor permits the correct ram location to be retained despite fluctutating air loads attempting to displace the ram position; the degree of sensitivity can be adjusted electrically to prevent hunting. Should any failure occur the system reverts to the trailing position.

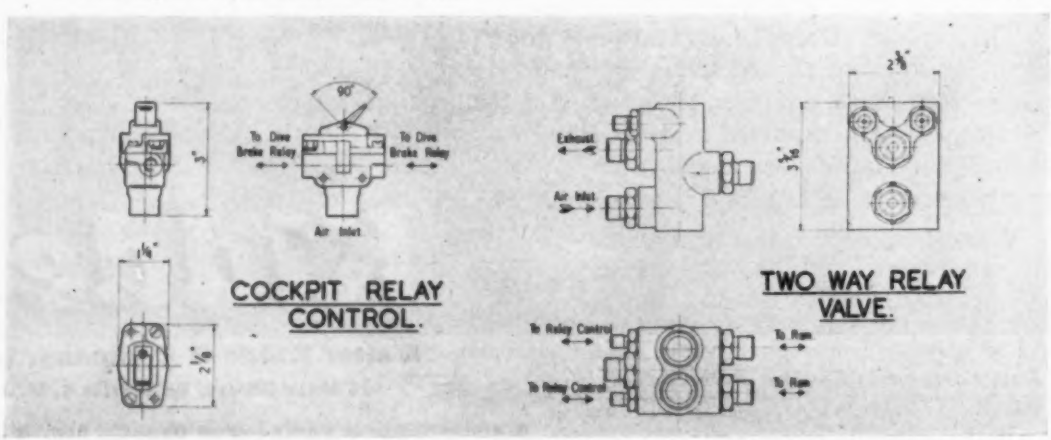
### *Pneumatic Rams or Actuators*

An almost infinite variety of pneumatic rams has been produced to meet various conditions and for this reason it is not possible to describe the many devices which have proved satisfactory. In general, however, it is of interest to note that the more recent actuators have employed light alloy cylinders and end covers, the piston rod or spindle being made from high tensile steel with the bearing or rubbing surfaces chrome-plated. Wherever possible, the design is arranged to insure that the piston does not come into contact with the cylinder wall, the spindle being carried in close fitting bronze bushings, provided with grease-retaining rings and scrapers at the outer ends arranged to prevent dirt from entering. In designs for high pressure rams, a large clearance between the piston and cylinder cannot be tolerated because of the danger of the piston seal extruding into the gap. For this reason, a patented piston has been produced which prevents the seal from extruding into the gap and at the same time provides a piston bearing surface which is compatible with the cylinder material.

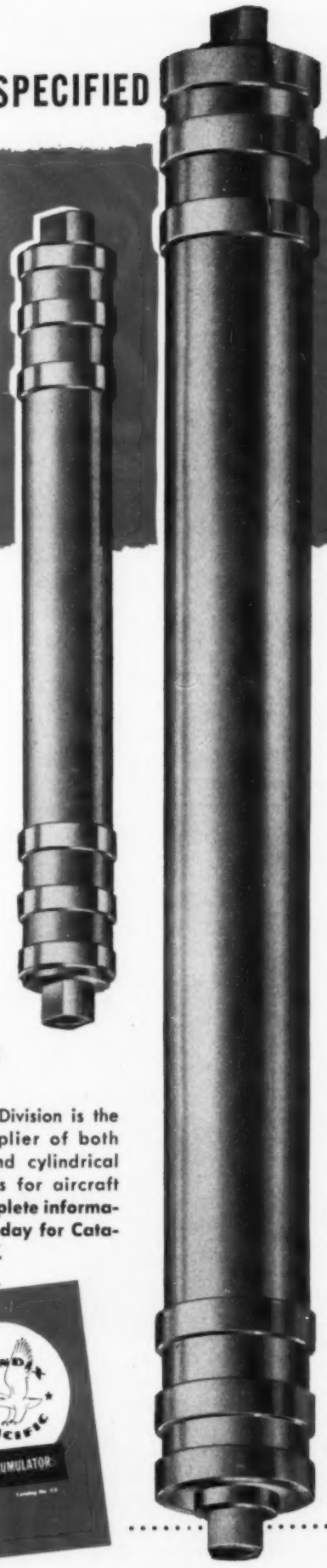
It has not been found necessary to introduce elaborate means for lubricating pneumatic cylinders, even in those services which are operating continuously, such as the radiator flap control rams on piston engines. Experience spread over the last five years or more indicates that an initial coating of a suitable lubricant provides adequate lubrication for at least 10,000 operations.

Most pistons and gland seals are now made of natural rubber in order to cope with very low temperature requirements. It has been found that all types of synthetic seals, including square, rectangular, round and lip type seals, start to leak at temperatures below

FIG. 6. TYPICAL RELAY valves for high pressure pneumatic systems. The cockpit relay control is very small and versatile. Push button control may be used instead of the lever shown. Low pressure air, e.g. 200 psi, will actuate large high pressure control valves, using ⅛ in. tubing between relay and valves.



# ALREADY SPECIFIED BY 17 MAJOR COMPANIES...



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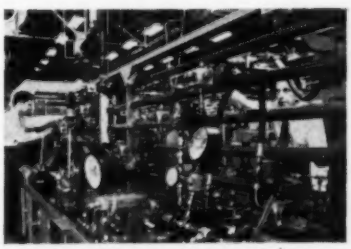

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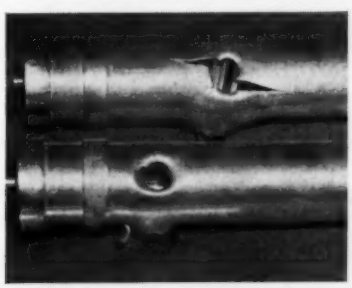

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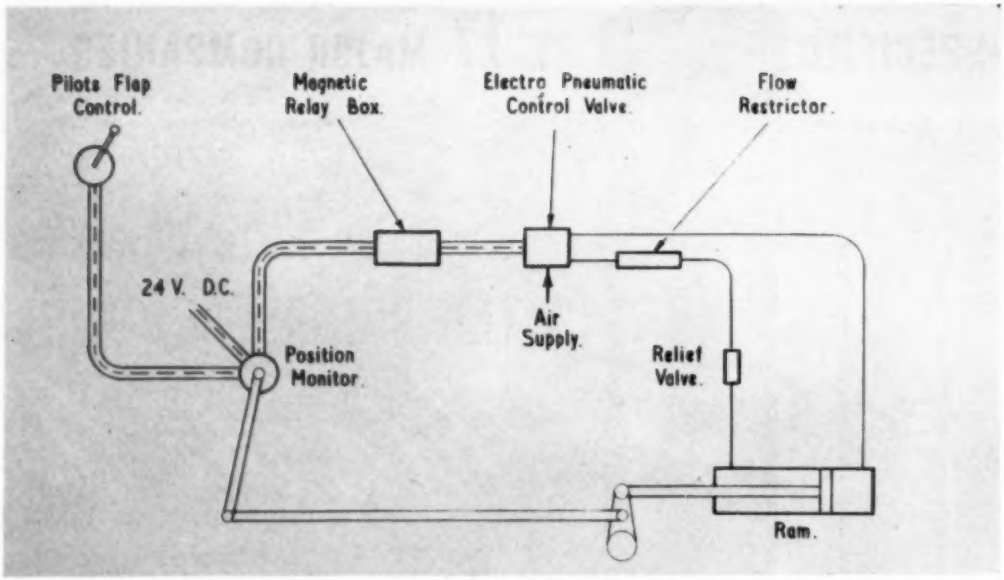


**FIG. 7. SCHEMATIC DIAGRAM** of an electro-pneumatic follow-up system for controlling wing flaps on a small aircraft. The follow-up valve is provided with a positive mechanical feed back providing 16 positions for the ram, with the greatest sensitivity around take-off and landing positions.

*All illustrations courtesy The Hymatic Engineering Co., Ltd.*

—40 F. Natural rubber, however, has proved satisfactory to —60 F. and lubrication of these seals with silicone grease has been satisfactory.

## *Development Trends*

Experience accumulated over a period of several years with two-stage compressors working at pressures up to 1000 psi has clearly established that for higher pressures it is desirable, if not essential, to introduce an additional compression stage. Although two-stage compressors have been capable of pumping to 4000 psi, the problem of heat dissipation becomes acute and places a severe limitation on the rotational speed of the compressor. As stated previously, the problem is accentuated by the necessity for lubricating compressors on low temperature oils whose lubricating qualities are generally inferior. The problems involved in raising the delivery pressure from 1000 psi to, say, 1500 psi, cannot be compared with that of a similar pressure rise in an aircraft hydraulic pump. The raising of the delivery pressure in an air compressor to this higher figure is not a matter of detail development but rather one of fundamentals associated only with air compression. At 1000 psi the over-all compression ratio is 69, i.e., about 8.3 per stage. If the same stage ratio could be employed in a third stage, the delivery pressure would be around 5700 psi. Unfortunately, a number of factors prevent this figure being reached, but, it has been found that a compressor having three stages is quite capable of pumping to 3000 psi without any risk of igniting the lubricating oil.

Figure 8 shows a small three-stage compressor capable of pumping to 3000 psi continuously at 1500 rpm. Inter-stage coolers are fitted between both stages, but no after-cooler has been found necessary because the delivery temperature does not exceed 284 F (140 C) and there is a rapid temperature drop between the compressor and storage bottle. Because of the facility with which generating pressures of 3000 psi can be attained, this pressure is likely to be standardized for some considerable time. While this pressure is lower than the latest hydraulic system pressures, it is high enough to meet the majority of aircraft requirements.

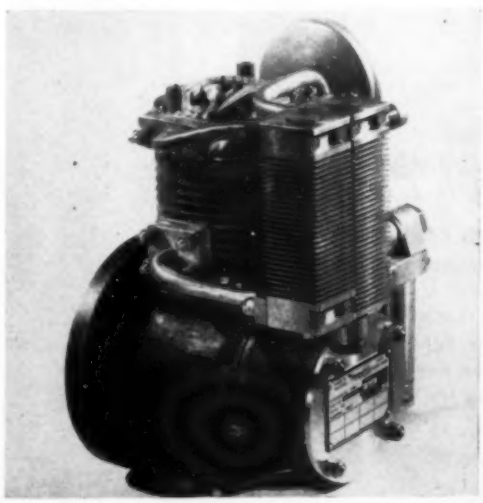

**FIG. 8. A CURRENT** design of a three-stage aviation compressor for 3000 psi continuous duty at 1500 rpm.

The development of compressors to work at 3000 psi and at speeds up to double the present speed is proceeding but difficulties of heat dissipation are considerable and, pending the successful outcome of current experiments, actual compressor speeds will remain in the 1500 to 2000 rpm. region. Where it

Continued on page 117

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*Pioneers in the Development of Aircraft Pneumatic Systems*

# Powered Flying Controls

**Application of aircraft servos and factors which influence their stability are discussed in this second part of a three part article.**

**Part 2**

**By F. J. Bradbury and S. M. Parker**

## *Typical Installations*

The difficulties encountered in applying servo-mechanisms to flying-controls are best illustrated by the consideration of a typical installation.

Two variations of such a system will be considered, the simpler of which is shown semi-diagrammatically in Fig. 3. In this arrangement the principle hydraulic feature is the use of constant pressure on the piston-rod side of the piston, while pressure is varied on the opposite side to achieve movement in either direction under the influence of the resultant net force.

In the neutral position, the valve plunger closes the port to the large area side of the piston and a condition of equilibrium is established, due to increase or decrease of the pressure in the closed end of the cylinder until the combined hydraulic and external loads on the piston are in balance. Movement of the control column in a clockwise direction causes the valve plunger to move to the right and allow fluid pressure to act on the large area side of the piston, thus causing the unit to extend and the control surface to move in a clockwise direction. This movement will continue if the control column is moved in unison with the control surface to maintain the valve in the open position. By bringing the control column to rest, the valve will be centralized, and closed by the final movement of the hydraulic jack and valve housing.

The main reasons for selection of constant pressure as a basic feature of these units may be summarized as:—

(1) simplified control valve;

(2) reduction in the effects of trapped air; and

(3) equal thrust in each direction without tail shaft.

The control valve is of the three-way type, and is easier to manufacture than the alternative four-way type required by a more conventional design. This permits close control of the tolerances that determine valve sensitivity.

F. J. BRADBURY and S. M. PARKER, Automotive Products Ltd., Leamington Spa, England.

*Adapted from a paper presented to the Institute of Mechanical Engineers, London, February,* 1952.

FIG. 3. Simple powered flying control system.

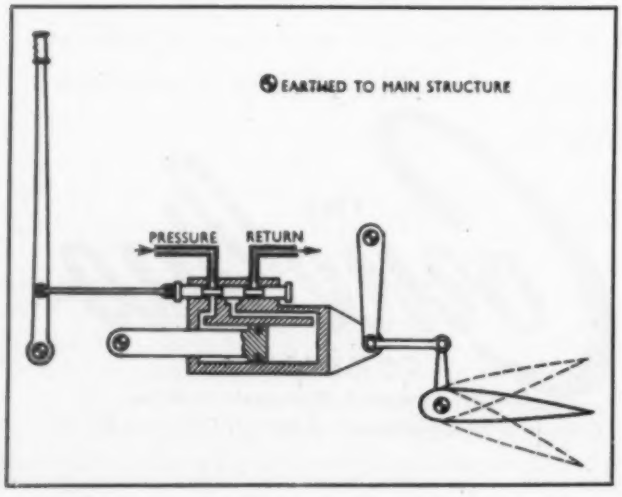
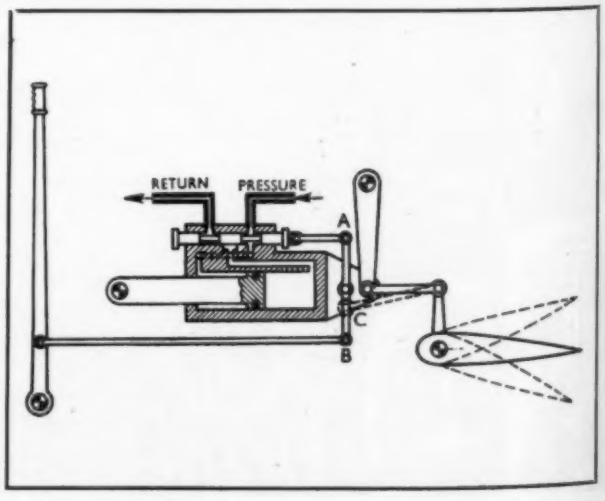



FIG. 4. Powered control system with differential lever.



Secondly, the fluid is under some degree of pressure, and thus any air it contains is also under pressure, which raises the bulk modulus of the two and provides an increased rigidity that contributes towards stability.

Lastly, when the cross-sectional area of the piston rod is half that of the the piston, equal thrust in each direction of axial movement is obtained without recourse to a tail shaft, which requires more space and increases friction by the addition of another sealing point.

A slightly more complex version of this system is shown in Fig. 4. The control valve in this system is operated through a differential lever AB, such that movement of the control column to the right, causes displacement of the valve plunger to the left and movement of the servo unit to the right. The only difference between this unit and that shown in Fig. 3 is that the action of the control valve is reversed. Although somewhat more complex, this system offers two advantages, firstly, a simple means of varying the velocity ratio between the control column and control valve and, secondly, a means of providing control "feel" by direct mechanical feedback of a proportion of the control-surface load. This latter feature may be obtained by connecting the link from the control surface to the differential lever at C, as shown by the dotted line.

In this way the pilot is provided with a true feel of the control-surface loads, which is often a desirable feature in aeroplanes with high-speed maneuverability.

It will be observed that in both these mechanically coupled systems, the transient error between the pilot's control and the control surface is limited by the movement of the control valve between its stops. This movement is made up of the "neutral", or "valve-closed" travel plus twice the amount of valve opening required to provide the specified maximum speed of operation. If the pilot endeavors to move his control at a speed greater than this, he will have to provide the whole of the necessary additional force. This is so marked that it provides an extremely effective load warning if an attempt is made to exceed the maximum rate of control movement specified by the designer.

The use of a mechanism that passes back to the pilot some proportion of the control-surface load has another advantage, in that it makes the system reversible; that is to say, it can be operated from either the input or the output end. This reversibility makes possible centralization of the pilot's control without artificial means. Conversely, the systems shown in Fig. 3 and by the full lines in Fig. 4 are not reversible, and are fundamentally different, particularly in their effect on stability.

## *Factors Affecting Stability*

Existence of a power source, or amplifier, in a servo-mechanism inevitably introduces a stability problem.

In nearly every case the actual cause of instability can be traced to some form of flexibility or backlash, or a combination of one or other of these factors with a very sensitive control valve. These factors can be analysed by considering the addition of suitable flexibilities to the basic system shown in Fig. 4.

Fig. 5 represents the condition in which there is flexibility S-1 in the anchorage of the servo-unit to the aircraft structure, combined with a very sensitive control-valve. In this case any disturbance which causes displacement of the output member (which is assumed to possess mass) will no doubt produce a self-excited oscillation. This is because in bringing the output member to rest, the anchor point D will move, due to the flexible mounting and, in so moving, will cause the differential lever AB to rotate sufficiently to open the control valve. In this way, energy can be fed into the system to move the output member while the input member is held stationary. Since the control valve is very sensitive and requires only small movements for power reversal, the sequence becomes self-sustaining, and oscillation at the natural frequency of the output circuit will occur. In this circuit must be included the stiffness of the hydraulic jack and its anchorage to the aeroplane structure.

FIG. 5. Irreversible system, with flexibility in the hydraulic jack and its mountings.

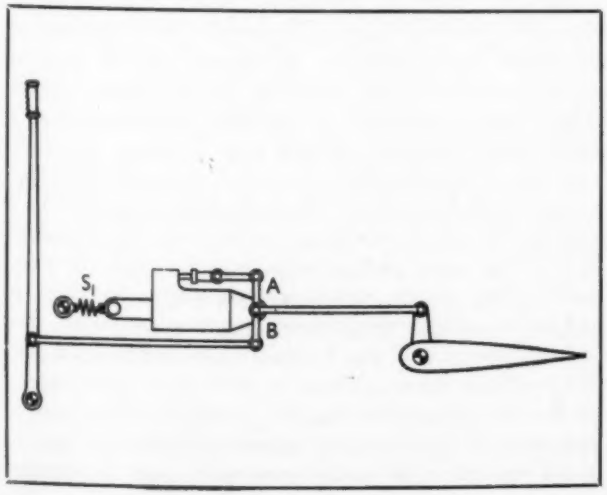
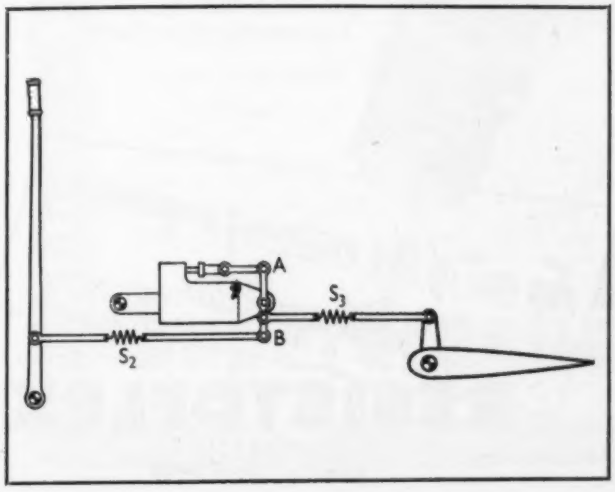



FIG. 6. Reversible system with flexibility in the input and output circuits.



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In Fig. 6 is shown an arrangement in which a proportion of the control surface reaction is fed back mechanically to the control column. In considering this system an assumption is made that the operating fluid and the anchorage of the servo-unit are rigid, and that the input and output circuits possess flexibilities represented by S-2 and S-3 respectively. It will be seen that instability may be initiated by a sudden disturbance in either the input or output circuits. The basic reason for this is that a disturbance in either of these circuits can cause movement of the differential lever, which can rotate against the flexibility of the other circuit. As an example, consider a disturbance set up at the control surface. This will be fed back through the output circuit and differential lever to the input circuit. In this case the flexibility S-2 of the input circuit will allow the differential lever to be displaced and will possibly open the control valve.

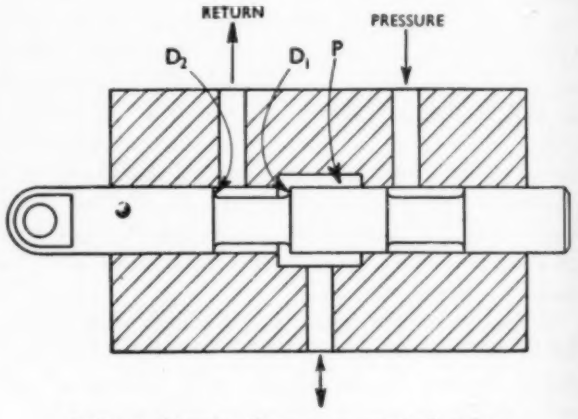


FIG. 7. Simple three-way control valve.

Such a valve opening causes the servo-unit to move and, depending on its phase relation with the motion of the output mass, feed energy into the system and produce self-excitation. It may be seen that flexibility in the input circuit reduces the effect of inertia damping which the control column could provide against an oscillation initiated in the output circuit. Furthermore, such flexibility reduces any stabilizing effect produced at the control column by the pilot. This form of instability is dependent on the amount of feedback provided, and becomes more difficult to stabilize as this is increased.

Another form of instability which may be experienced in certain types of hydraulic servo-mechanism is caused by hydraulic "unbalance" of the control valve combined with backlash in the input circuit. This form of stability is normally experienced as a fairly high-frequency dither. Fig. 7 shows that fluid entering or leaving the annulus P at small valve openings will do so at a relatively high velocity. As a result, the fluid pressure acting on the shoulder D-1 of the valve plunger will be lower than the pressure acting on the shoulder D-2, where the fluid is probably almost motionless. In this condition, the valve plunger will be hydraulically unbalanced and the resultant force will tend to move the valve plunger in the direction of the higher pressure, and so reclose the valve. In practice, the unbalanced force is usually small enough to be easily controlled from the control

column, but if backlash exists in the input circuit then the valve can oscillate within that backlash.

Existence of instability necessitates the self-excited release of energy within the system and, since this can only occur through the control valve, whatever the cause of instability, it must transmit its effect to the control valve. It is not surprising, therefore, that the control valve is often criticized for an unstable condition resulting from some other part of the system. However, within certain limitations much can be done to improve the stability of the simple proportional-control system by careful design of the control valve, which will be analysed in part three of this article in the October issue of APPLIED HYDRAULICS.

## Speed Coordination Problem

Concluded from page 75

machine. On the other hand, looser types of soil can be cut with the bucket line moving slowly and with the machine moving forward more rapidly, keeping the buckets in close contact with the front wall of the trench and assuring a maximum load in each bucket.

To set up the machine to dig, the unit is halted at the point the trench is to begin and, with the engine running, the master clutch is disengaged, the bucket line clutch is engaged by movement of its lever, the master transmission is put into the gear desired and the master clutch reengaged.

Then the digging boom is lowered by moving the boom lever down. The lever is operated slowly and intermittently until the boom contacts the soil and penetrates to the desired depth. At this time, or slightly before, depending on the character of the soil to be dug, the hydraulic control lever is moved down. This opens the pressure port in the multiple valve to the hydraulic motor, integral with the auxiliary transmission. This starts the forward motion of the ditcher. The speed desired for the cutting operation is controlled by the flow control valve, located conveniently to the hydraulic control valve lever.

When the hydraulic control lever is in its neutral position, the hydraulic lines are locked, holding the ditcher against rolling in either direction, a distinct advantage when the equipment is operating on hilly terrain.

The hydraulic system consists of a 7½ gpm vane pump, V-belt driven off the engine, a 13½ gallon reservoir equipped with a suction line filter, a 5 inch pull type ram with a 22 inch stroke for lowering and raising the boom and a special three section multiple spool valve and a piston type fluid motor.

The motor is controlled by two detent sections; one controlling direction and the other valving the speed control valve in and out. Both sections are operated by one handle and linkage that gives controlled speed in the forward directions, and maximum speed in reverse. Centering springs return the boom operating valve to neutral when the handle is released. The pump discharges to tank when all handles are in neutral, and both hydraulic motor anl cylinder ram are positively locked hydraulically.


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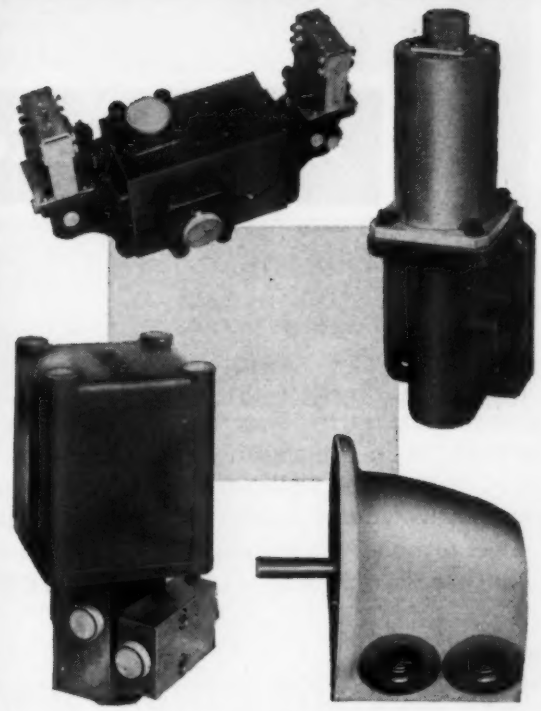

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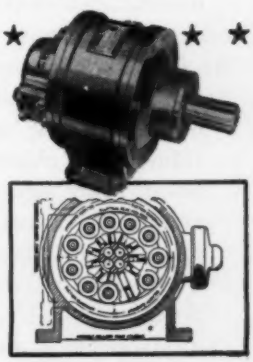

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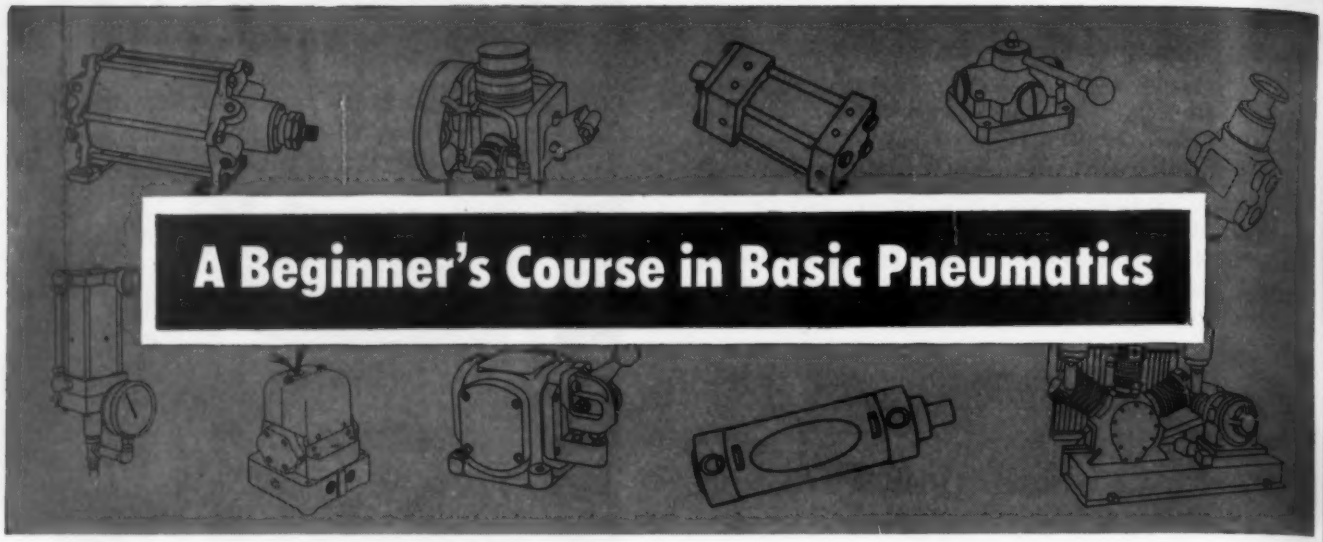

# A Beginner's Course in Basic Pneumatics

## Section 1

## Air Properties and Characteristics

### Part VIII

### Volumetric Efficiency

THE volumetric efficiency of an air compressor is the ratio of the actual air delivered to the piston displacement.

Volumetric efficiency is, perhaps, the most misunderstood term used in the rating or in the capacity of a compressor. The true or actual volumetric efficiency is measured at intake conditions; it is not piston displacement. The discharge pressure of a compressor has nothing to do with its capacity. Volumetric efficiency is not a percentage of air that is drawn in relation to the air delivered.

The most common method of rating compressors and the one found in most manufacturers' catalogs, is displacement in terms of cubic feet per minute (cfm). It is obtained by multiplying the area of the piston (bore squared x 3.1416 over 4) by the stroke and the rated speed in rpm. This, however, is an ideal figure, never attained in practice due to the need for a clearance volume at the top of the cylinder and around the valves. Piston displacement or nominal displacement is the space displaced by the piston as noted in the paragraph above. It is simply:

area of piston x stroke x speed in rpm

The volumetric displacement of a compressor is obtained by multiplying the nominal displacement by the volumetric efficiency.

Since piston displacement and cylinder volume are frequently confused, we had better take a look at these terms before we go on. Cylinder volume is the total volume of a cylinder containing both piston displacement and the clearance volume. This relationship is shown in Figure 1.

Volumetric efficiency is of value principally as a means of determining the capacity of a compressor, i.e., the actual output of air available for operating components. It is not a gauge of economical performance, since it refers only to capacity. Some compressors have high volumetric efficiency and low overall efficiency and vice versa. Designers and buyers alike seek a large air output for a small power input.

It is very simple to determine the nominal displacement of a compressor that must be selected to take care of a definite air requirement when the volumetric efficiency is known. For example, a plant requires, including a reserve capacity for future expansion, a total of 2000 cfm of free air compressed to 100 psi; the volumetric efficiency is 86 percent.

$$\text{Since volumetric efficiency} = \frac{\text{delivered capacity;}}{\text{displacement}}$$

$$\text{displacement} = \frac{\text{delivered capacity.}}{\text{volumetric efficiency}}$$

$$\text{Therefore } \frac{2000}{.86} = 2326 \text{ cfm displacement.}$$

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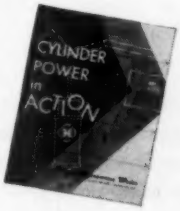


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HYDRAULIC AND PNEUMATIC EQUIPMENT...CYLINDERS...VALVES...RIVETERS

The indicator diagram has been used very commonly in the past as a means of determining the volumetric efficiency. In the indicator diagram, Figure 2, the line AB is the volume apparently delivered at intake condition; CD is the piston displacement. Volumetric efficiency by definition $= \frac{AB}{CD}$. In the diagram, AC represents the loss due to suction and AD the clearance volume. Both of the latter are at intake pressure. Volume AD is re-expanded at intake pressure, thus it is the maximum volume of air not expelled at discharge.

The actual delivery of a single stage compressor working at 100 psi gauge from atmosphere will be between 65 and 80 percent of its piston displacement, depending on the clearance volume and valve design. The actual volumetric efficiency decreases with an increase in compression ratio. The ratio of compression, as we have pointed out previously, is the relation between the initial and final pressures during compression, expressed in absolute units.

Volumetric efficiency depends on pressure and temperature at the end of admission, quality of the air at the end of admission and on clearance volume.

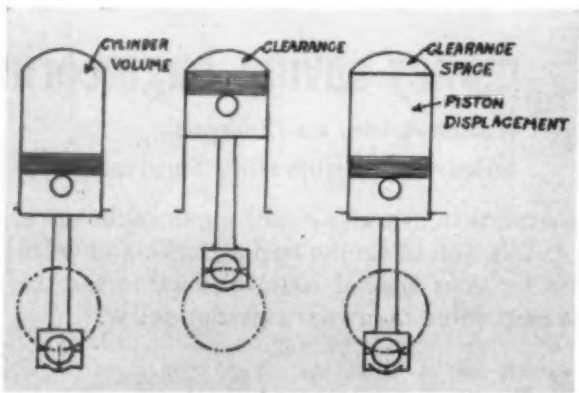


FIG. 1. The relation of piston displacement, clearance and cylinder volume.

The charge, or amount of air taken in at the end of the admission stroke, is at less than atmospheric pressure due to frictional resistance met by the air as it is sucked into the compressor cylinder. This is shown schematically in Figure 3, where the terminal admission pressure at D is below atmospheric line EF. In this case, neglecting clearance, the volumetric efficiency would be $\frac{EF}{CD}$.

Temperature also must be considered. The phenomenon commonly called false or boosted pressure is always present due to the effect of the heat of the cylinder walls on the charge, the gradual reduction in piston speed as the piston nears the end of the admission stroke and the inertia or friction effect.

Figure 4 illustrates an exaggerated effect of false or boosted pressure. Under unusual conditions the combined effect of such heating and inertia or friction, the charge pressure may be raised above atmospheric pressure. The range of error in indicator diagrams for admission effects is from 4 to 12 percent.

**Cylinder volume:** the total volume of a compressor cylinder, the piston displacement plus the clearance volume.

**False or boosted pressure:** the pressure effect on charge of entering air due to heat and inertia or friction that tends to raise the pressure above the atmosphere pressure.

**Clearance:** the volume of air remaining in the cylinder at mid-stroke that is not expelled at discharge.

**Overall efficiency:** the combined efficiency of an air system found by multiplying the several individual efficiencies. Often it is defined as the product of compression efficiency and the mechanical efficiency (compressor efficiency).

**Piston displacement:** the volume displaced by the full stroke of the piston in one cycle.

**Volumetric efficiency:** the ratio of the actual air delivered to the piston displacement.

**Slip efficiency:** the ratio of air actually measured to the apparent volume as shown by an indicator diagram. It covers the quantity of air not otherwise accounted for.

---

### *Clearance*

Clearance in an air compressor cylinder is the volume of air that remains in the cylinder at the mid-position (Figure 1). It is the volume not expelled at discharge. Many modern compressors are made with generous clearances because of the design advantages, e.g., larger valve areas. The effect of clearance is to lower the compression curve slightly. However, since the horsepower required and the volume of air delivered from the cylinder are reduced in almost the same ratio, the horsepower per cubic foot of air compressed and delivered remains unchanged and clearance, therefore, has no effect on compression. The principal effect of clearance is to increase the size of the cylinder required without appreciably increasing the horsepower.

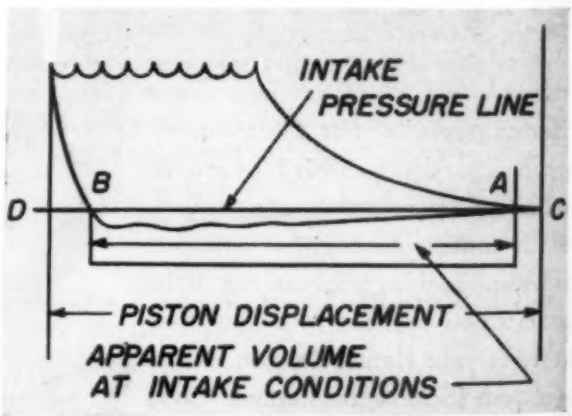


FIG. 2. Indicator diagram showing relation of apparent volume at intake conditions, suction and clearance to piston displacement.

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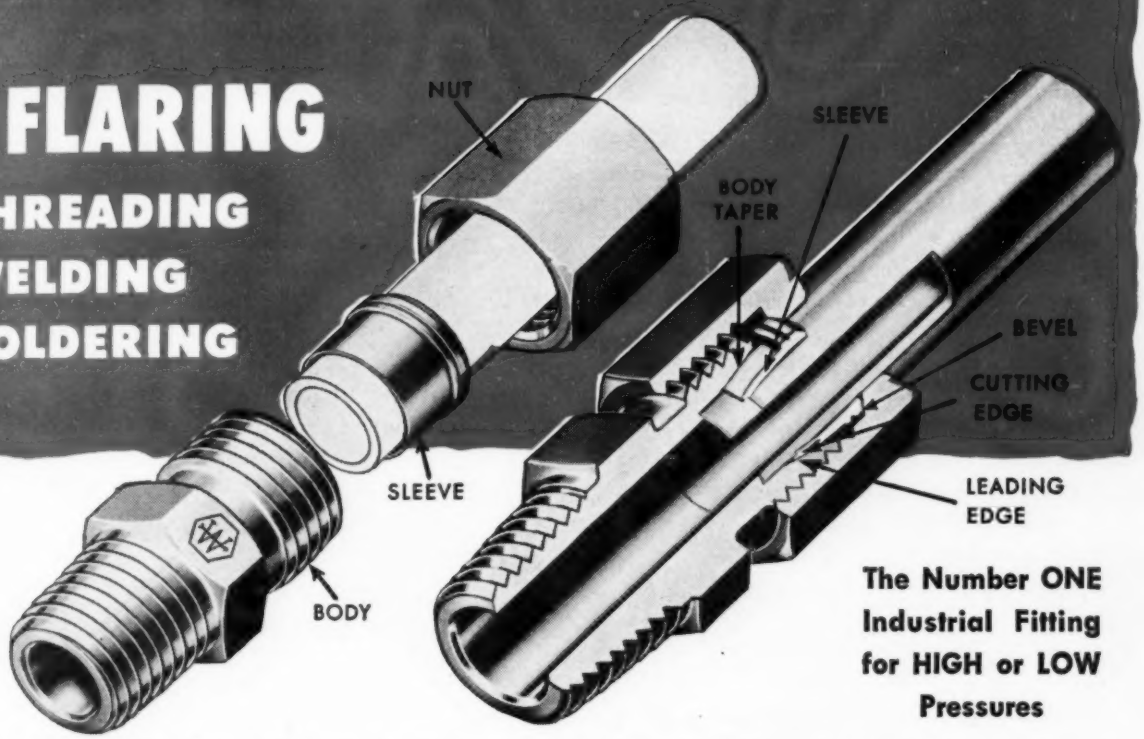


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As nut is tightened, it forces the sleeve forward into the taper of the body.

The leading edge of the sleeve contracts, thereby forcing the cutting edge of sleeve to shear a groove into outer surface of the tube, making a positive seal between fitting and tube.

The nut presses on the bevel of sleeve, causing it to clamp tightly to the tube. Resistance to vibration is concentrated at this point rather than at groove in the tube.

When fully tightened, the case-hardened sleeve is bowed slightly at the mid-section and acts as a spring. This spring action of the sleeve maintains a constant tension between the body and the nut, thus preventing the nut from loosening.

After the first assembly the sleeve is permanently attached to the tube. Disassembly and reassembly of the fitting can be made without loss of strength or sealing qualities.

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The effect of clearance may be easily understood from an example. First, we will take an example, disregarding clearance; then refigure the same data, taking clearance into consideration.

If we assume at the beginning of a compression stroke that the nominal displacement is 9 cubic feet, pressure is atmospheric, compression is isothermal and assuming no clearance, we readily see that the pressure at mid-stroke is a direct volumetric ratio:

$$IP \times IV = FP \times FV = 14.7 \times 9 = FP \times 4.5 \text{ or}$$

$$FP = \frac{14.7 \times 9}{4.5} = 29.375 = 29.4 \text{ psi absolute or}$$

$$29.4 - 14.7 = 14.7 \text{ psi gauge.}$$

However, the clearance volume must be considered. If, in our example, the clearance was 6 percent, the mid-stroke pressure with isothermal compression would be found as follows:

Assuming, as before, that the nominal displacement per stroke is 9 cubic feet, the entrance volume would be:

.06 x 9 cu. ft. = .54 cu. ft. clearance volume; plus
9 cu. ft. = 9.54 cu. ft. cylinder volume.

At mid-stroke the piston displacement would be as before 4.5 cu. ft. This would give a total volume at mid-stroke of:

4.5 cu. ft. plus .54 cu. ft. = 5.04 cu. ft.

Solving as above:

$$IP \times IV = FP \times FV = 14.7 \times 9.54 = FP \times 5.04 \text{ or}$$

$$FP = \frac{14.7 \times 9.54}{5.04} = 27.8 \text{ psi absolute or}$$

$$27.8 - 14.7 = 13.1 \text{ psi gauge}$$

We have not as yet touched on multi-stage compression or on the ratio of compression involved between single stage and two-stage compressors at a given discharge pressure. For the present it is sufficient to remember that the piston displacement of any multi-stage compressor is defined as the piston displacement of only the first stage cylinder. Since only the first stage cylinders take in new air, the volumetric efficiency is actually determined in this stage. Ratios of compression will be covered in detail later. There is a common misconception that two stage compressors are more efficient than single stage compressors. They may or may not be; while two stage compressors have a higher volumetric efficiency, they no not have a higher overall efficiency.

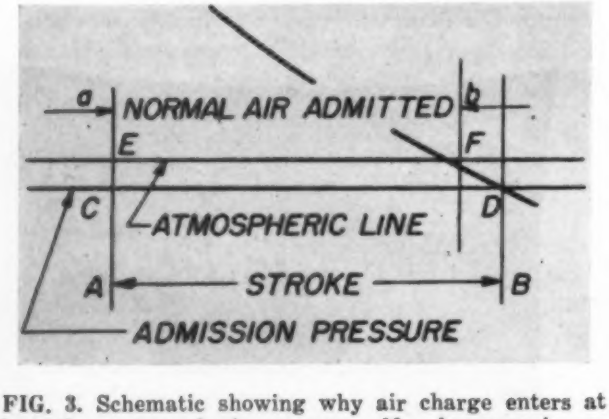


FIG. 3. Schematic showing why air charge enters at less than atmospheric pressure. No clearance is assumed.

### *Overall Efficiency*

Overall efficiency is the combined efficiency of a system composed of two or more elements; it is the product of the efficiency of each element.

Overall efficiency for a power driven compressor is obtained by multiplying the compression efficiency by the mechanical efficiency by the overall efficiency of the prime mover and the transmission, from the power input back to the theoretical horsepower required.

In a previous installment (August issue) we determined that the adiabatic compression efficiency of a single stage compressor was 81 percent. Assuming a mechanical efficiency of 92 percent (mechanical efficiency i.h.p. an electric motor efficiency of 90 percent and a coupling efficiency of 98 percent, we determine the overall efficiency as:

$$\left(\frac{\text{i.h.p.}}{\text{b.h.p.}}\right),$$

Compression efficiency x mechanical efficiency x motor efficiency x coupling efficient or

.81 x .92 x .98 = .657 percent

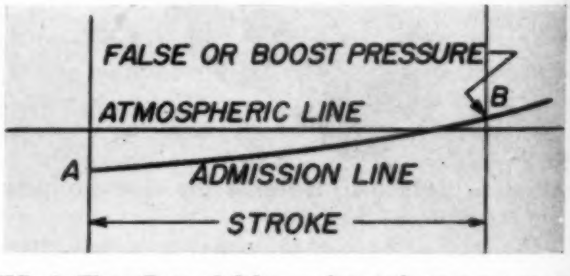


FIG. 4. The effect of false or boosted pressure on entering charge.

A word of caution must be given here. Some authorities define overall efficiency as the product of the compression efficiency and the mechanical efficiency. This product we have previously defined (August issue) as the compressor efficiency. In the example given this would be:

.81 x .92 = .745 or .75 percent.

Be sure just what is involved when the term overall efficiency is used.

Overall efficiency of the compressor alone or compressor efficiency is of major importance to buyers and users of compressors since it is the ratio of theoretical horsepower required to compress air actually delivered and the actual horsepower input. It is important also to know whether the isothermal or adiabatic base is used for theoretical horsepower; since the ratio of theoretical horsepower to the adiabatic base is higher than the theoretical horsepower to the

Concluded on page 118

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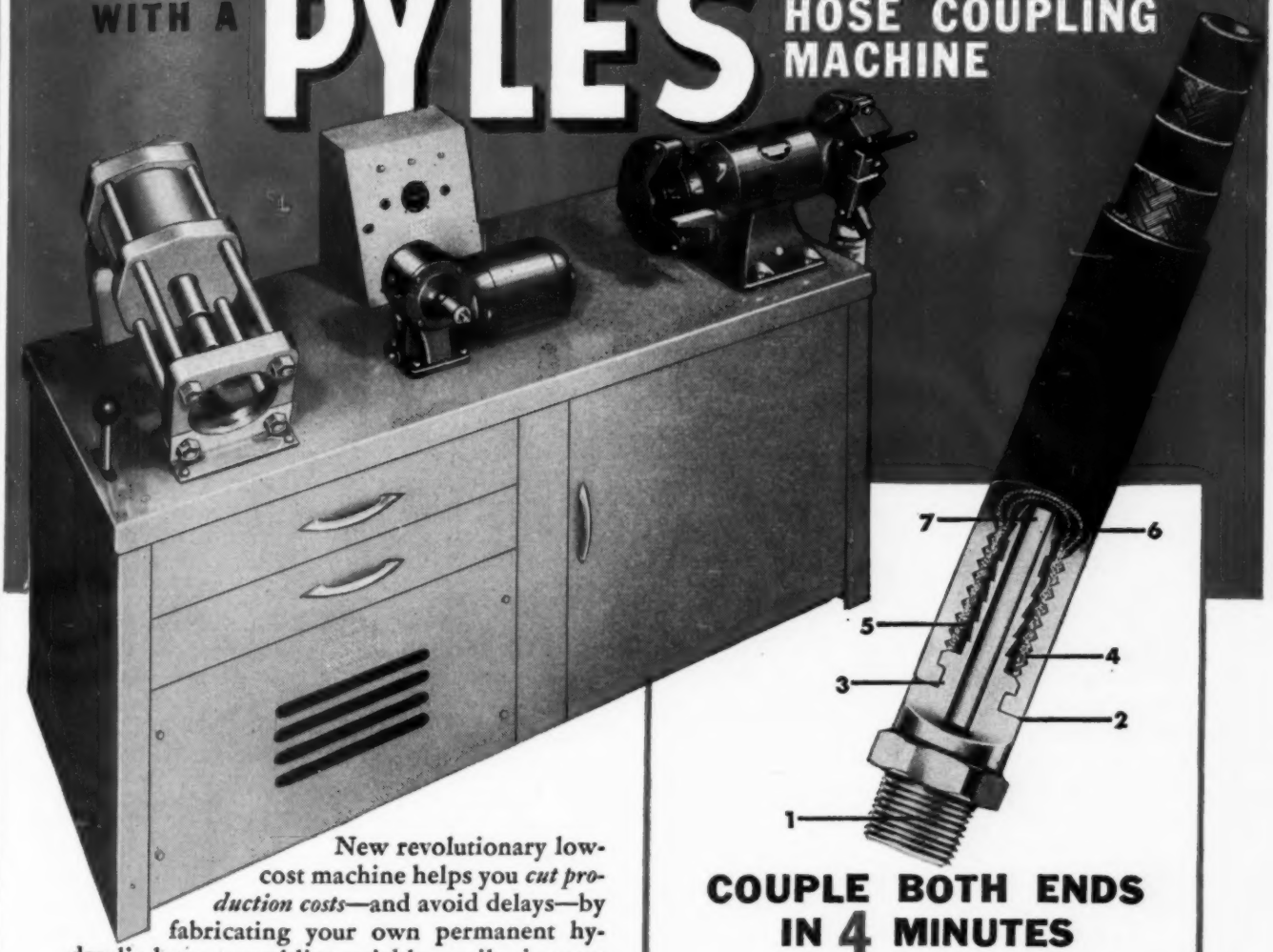
## WITH A PYLES HOSE COUPLING MACHINE



New revolutionary low-cost machine helps you *cut production costs*—and avoid delays—by fabricating your own permanent hydraulic hose assemblies quickly, easily, in your shop.

Pays for itself in a matter of weeks! Does complete assembly and swaging job. Produces a finished hose, coupled at both ends, in 4 minutes. The Aro 2-piece steel coupling used in the process takes greater pressure, prevents breathing, resists corrosion, gives you a BETTER hose assembly than you've ever seen before! Write today for bulletin No. 8; for hose assembly only, bulletin No. 9

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APPLIED HYDRAULICS

# Post Scripts of Industry

**News about people, manufacturers and sales organizations**

## Aviation News

**John C. Buckwalter** has been named chief engineer of the Long Beach, Calif., plant of **Douglas Aircraft Co. Inc.** He moves up to this post from assistant to the vice president of engineering at the Santa Monica plant of Douglas.

**Burt C. Monesmith** has been elected a vice president of **Lockheed Aircraft Corporation,** according to an announcement made by Robert E. Gross, president. Mr. Monesmith's new title is vice president and manufacturing manager. He has been with Lockheed since March, 1946 and has served as general superintendent in charge of assembly, works manager, assistant to the vice president in charge of manufacturing, and since May 1950, as manufacturing manager.

**Edward T. Boggs** has joined the Helicopter Division of **Bell Aircraft Corporation** as test engineer of the Kenmore Plant. Formerly he was research mechanic with McDonnell Aircraft Corporation, St. Louis, Mo.

**C. Kenneth Baxter,** president, **Donner Corporation,** Philadelphia, announces the purchase of the majority interest in Air Associates, Inc., of Teterboro, N.J. Mr. Baxter states that no changes in management of the new subsidiary are contemplated for the present.

**Charles E. Temple** has been appointed assistant contract administrator for Pacific Airmotive Corporation, according to an announcement by Neal J. Coleman, vice president in charge of contract administration. Mr. Temple was formerly engaged in similar activities for Phillips Aviation Company and Convair.

**For the first time aviation news items are published separately from the industrial news items. You'll find industrial news on pages 146-149.**

**Andrew F. Haiduck,** vice president of **Lear, Inc.,** has advanced to general manager of the corporation's Grand Rapids Division. Previously he was manager of the Romec Division at Elyria, Ohio.

**Lowery L. Brabham** has been named a vice president of **Republic Aviation Corp.** Formerly sales manager, he will continue to direct sales activities.

The **Aeronautical Division,** Minneapolis-Honeywell Regulator Co. has set up a new hydraulics testing laboratory in Minneapolis, designed particularly to work with a servo mineaturization program.

H. Mansfield Horner, president of **United Aircraft Corporation,** announces three promotions of officers: **William R. Robbins,** controller, was named a vice president; **William P. Gwinn,** general manager of the Pratt & Whitney Aircraft division and a vice president, was named a member of the corporation's operating and policy committee; and **Erle Martin,** general manager of the Hamilton Standard division, was elevated to a vice presidency.

**R. E. Strasser** has been named as design engineer by the **William R. Whittaker Co., Ltd.,** Hollywood, Calif. He had held the same title with Hydro-Aire, Inc. previously.

**Donald S. Campbell** has been named by **AiResearch Mfg. Co.** as technical representative in London, on assignment with Joint Military Assistance Group of MDAP.

**Leonard J. Platt** has been named wage and salary administrator for Pacific Airmotive Corporation, according to an announcement by J. T. Berger, industrial relations director. Platt has a considerable background in industrial relations in the aviation industry, having been associated with Douglas Aircraft Company at Long Beach, Northrup, international division of TWA and C.A.A.

Continued on page 99

PRESENTING THE AIR-OPERATED

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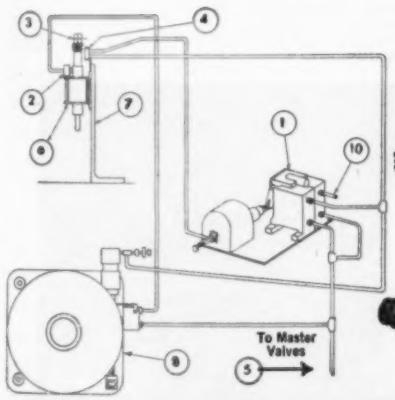
TIME and again Mead Work Feeders—using clean, inexpensive Air Power—have stepped up small piece production from 200 to 2,000 pieces per hour and more! Remember—it isn't the material in these "small piece" jobs that makes them expensive—it's the labor cost in feeding, holding or assembling them. Get the facts. See how you can save time, money, labor and increase profits with these ingenious air-operated MEAD Work Feeders. Write for Mead AIR Power Catalog.

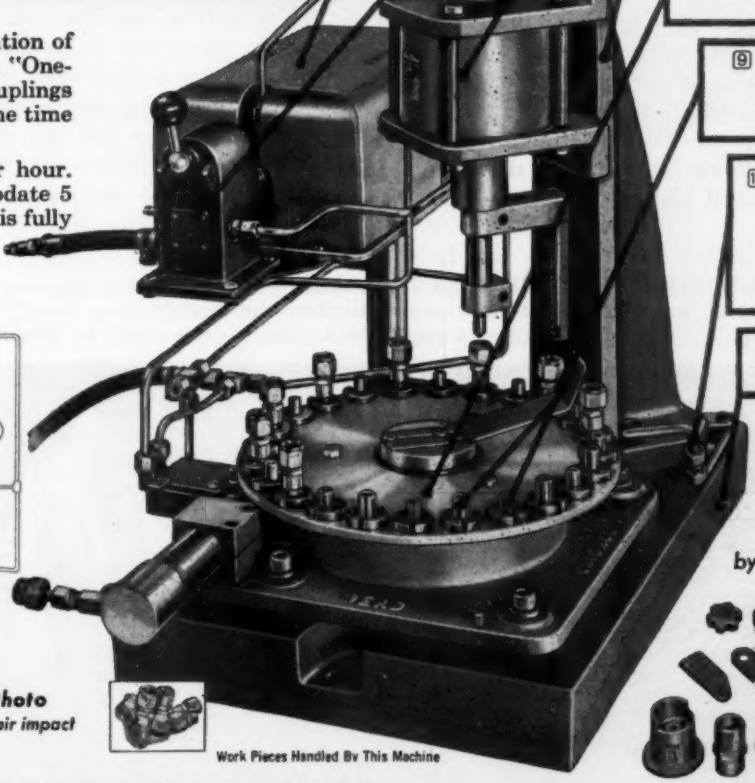
A simple and inexpensive combination of Mead pneumatic devices makes a "One-Man Factory" to assemble brass couplings by flaring neck into nut, at the same time forming a fluid-tight seat.

Output approximately 2500 per hour. Two sets of 12 mandrels accommodate 5 different styles and sizes. Operation is fully automatic except for loading.




***Circuit Diagram of Units in This Photo***

*Combine readily to feed work to drill press, air impact hammer for a wide variety of operations.*




Work Pieces Handled By This Machine

1. *Model 2 Meadmatic Timer*
2. *#2 Quick Exhaust Valve to speed up return stroke*
3. *Adjustable depth stop with spring return*
4. *Cycle release valve (included with timer) to reverse cycle at end of down stroke*
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6. *Single Acting Cylinder, 4" bore*
7. *Vertical Stand*
8. *Rotary Work Feeder*
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10. *Air blast ejection of finished parts, by jet piped from second of two valves in timer*
11. *Universal Base*

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# Keeping Going Under Difficulties

***How ingenuity plus cooperation at the Glenn L. Martin Co. kept a stretch press operating on sheet too heavy for the original design.***

WHEN a production schedule on a new airplane at The Glenn L. Martin Co. plant called for heavier gage aluminum skins, an immediate crisis developed. An Erco stretch press, adequate for previous sheet forming, was not rugged enough to handle the new heavier sheets.

New heavier duty presses were ordered but could not be received in time to relieve the situation. Production had to be stepped up to meet the new schedule. The first step was to keep the press going, if possible.

The first emergency move was to install a pair of manually operated jacks, one on either side of the sheet, to reinforce the pulling power of the jaws as they formed the sheet. However, this arrangement meant that there was approximately 20 minutes downtime on the machine for each sheet that was processed.

A better answer had to be found and found quickly. Through the cooperation of the Design Group of Tool Engineering, Machine Maintenance, the Welding Department and Detail Manufacturing, such an answer was found.

The modification was to replace the hand screw jacks with hydraulic rams or cylinders operated by a portable power unit. Since the reinforcing rams were to operate automatically, sheets could be fed into the machine continuously.

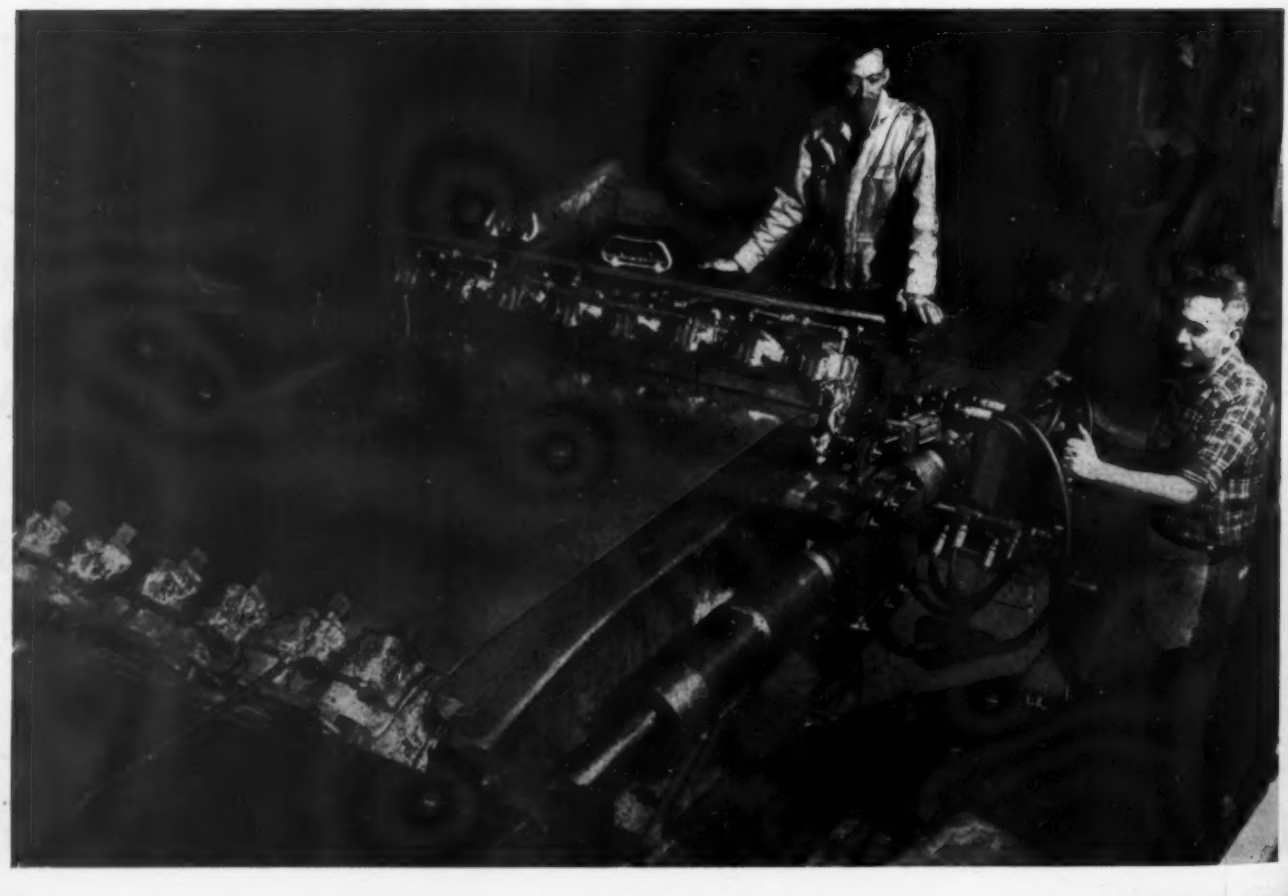
The cylinders were purchased new but the hinge and lock assemblies had to be designed, machined out of raw stock and the main sections of the cylinders reworked from the hand screw jack components for fitting.

The Design Group and Machine Maintenance worked very closely, the latter doing all the machining work in their small shop. Once, when stymied because the cylindrical sections could not be accommodated by the steady-rest on their lathe, they hit upon the idea of building a steady-rest of steel and masonite for the job. Working successively through three shifts with no drawings, the improvised steady-rest was finished and put to use the next day.

When the ram sub-assemblies were well under way,

Concluded on page 154

**THE RAM AND HINGE** assembly, installed as an emergency measure, permitted this stretch press to handle heavier sheets than the machine was designed originally to handle. The arrangement was used until heavier presses could be obtained.



## Lockheed Engineers Occupy New Building

Lockheed president Robert E. Gross, in officially opening the new three million dollar engineering building which will house over half of the 3300 engineering personnel of the company, recalled that 20 years ago only six aeronautical engineers were on the payroll.

The modern structure, one of the West's largest industrial office buildings, provides four floors for Lockheed's aircraft designing staff, a basement built to resist atom bombing and a "brain room" that houses electronic calculating machines.

The 392 foot long building has steel walls, constructed of corduroy-shaped panels only three inches thick, on its two long sides. The end walls are of concrete. The interior, designed to be both flexible and functional, provides utility lines and air conditioning ducts in subfloor channels.

The engineering staff, headed by Hall L. Hibbard, vice president and chief engineer, are working on all four major aircraft types—transports, fighters, bombers and trainers—as well as secret activities in the most highly advanced fields of aeronautics.

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## Aviation News

Continued from page 96

**William J. Skelley,** design draftsman for **Bell Aircraft Corporation,** has been transferred from Buffalo to Fort Worth.

**A. V. Fant** has been named chief engineer of the Aircraft division of **White Motor Co.**

**A. N. Ballard** and **D. J. Halsey** have joined White at the same time as division manager and project engineer respectively. All three were previously with Convair.


# DENISON

## AIRCRAFT HYDRAULIC PUMPS

*Model AP3V Variable Volume*

**Faster, farther, higher, and *safer* . . .**

As new records are set almost daily in every phase of aircraft performance, more and more responsibility falls to those who make operating components for these planes. Additional power, speed, precision, control and dependability must be built into smaller and lighter-weight units wherever possible.

The aircraft pump shown above is an example of how, through intensified research, Denison's long, specialized experience in hydraulics is applied to the job of keeping ahead of these ever-growing demands. This 3000 psi, compensator controlled pump, rated at 3 gpm at 1500 rpm, features excellent suction characteristics . . . extremely high over-all efficiency . . . and rugged, compact dependability that simplifies the designer's problems.

We are interested in any opportunity to help with your requirements for high pressure aircraft pumps and pressure controls. We will gladly send you complete specifications upon request. Also, if one of our specially qualified engineers can be of help to you, just let us know. Write today.

Other Denison aircraft components for circuit needs up to 5000 psi include Constant Volume Pumps . . . Relief Valves . . . and Surge Damping Valves that prevent damaging pressure shock.

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# Would Swivel J

*To die casting machine builders the application of a flexible piping system is not new. Many of their designs would not be possible without swivel joints or hose. You probably aren't building die casting machines, but you'll find that many of your hydraulically actuated machines involve similar problems of adjustment—problems which can be easily solved by the careful selection of flexible piping.*

**By Richard M. Olsen**

TO permit easy adjustment of die platens on die casting machines, a flexible piping system must be designed. Because the die closing cylinder is rigidly bolted to a platen, as the platen is moved on the tie rods during die setup, the cylinder piping must be free to move within the range of platen adjustment.

Obviously, the use of rigid piping would require the services of a pipe fitter to break and remake the pipe fittings with every new setup. This would be costly, time consuming and probably result in early failure of the hydraulic system because of leakage and oil contamination. Under these conditions, no designer would consider using rigid piping.

---

RICHARD M. OLSEN, Design Engineer, Kux Machine Company, Chicago, Illinois

The problem can be readily solved by the use of hose or rigid piping connected with swivel joints. On the Kux BH-30 C die casting machine, we chose swivel joints and piping for several reasons. First, the amount of adjustment required is easily within the turning range of swivel joints and short lengths of pipe. Second, adjustment is only required at infrequent intervals. Flexible piping is used in two places on this convertible machine. Figures 1 and 3 show the application on the die closing cylinder, and Figure 2 shows the piping on the gooseneck injection unit.

This convertible type machine can be changed from zinc or gooseneck operation to aluminum or cold shot operation rapidly and with a minimum of attachments. This changeover requires the removal of the gooseneck bridge, seen in Figure 2, and putting

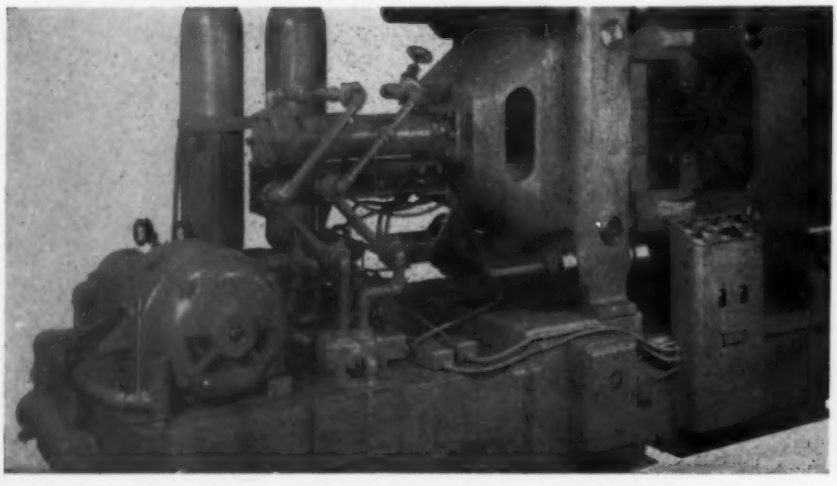


**FIG. 1.** Flexible piping is used on the die closing cylinder to permit adjustment of the die platens when setting up dies. Layout must be carefully made to avoid interference.

# Joints Speed Your Machine Adjustments?

## . . . they do on this convertible die casting machine

in its place the cold chamber unit. Use of swivel joints on the gooseneck injection unit helps to speed this changeover. They permit adjustment of the injection unit to maintain perfect nozzle contact with the die.

The accompanying photographs clearly show the piping layout. Use of rigid piping and swivel joints require careful layout to avoid interference and assure proper travel. The joints used on this installation are a ball type design. Designers have a wide choice of standard joints for hydraulic service. Steel joints which will operate satisfactorily without leakage up to a system pressure of 2000 psi are used on this die casting machine.

The ball joint provides movement in all planes, 360 degrees rotation plus 30 to 40 degrees flexing. The joints do not restrict the pipe diameter and therefore do not create excessive turbulence or any greater pressure drop than a regular elbow fitting. The ball of the joint seats itself under pressure in gaskets to provide a leakproof seal. A variety of styles gives the designer considerable flexibility in his piping arrangement. Other swivel joint designs using ball bearings are also available for flexible piping installations. They provide extremely efficient operation on applications which require frequent movement of the piping.

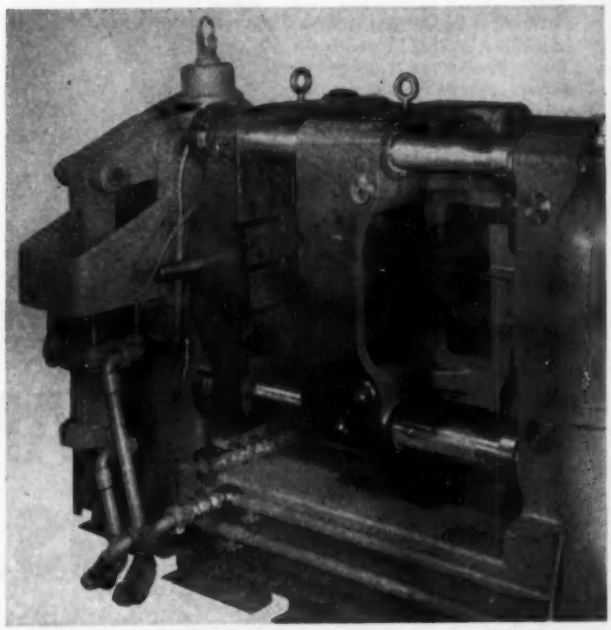


FIG. 2. The hydraulic gooseneck injection unit is supported by a massive cast steel bridge mounted on the side frames. Side mounting of the cylinder eliminates danger of oil leakage into the melting pot and furnace and prevents damage to the hydraulic cylinder from the heat. Flexible joints on cylinder piping permit adjustment of the injection unit to maintain perfect nozzle contact with the die.

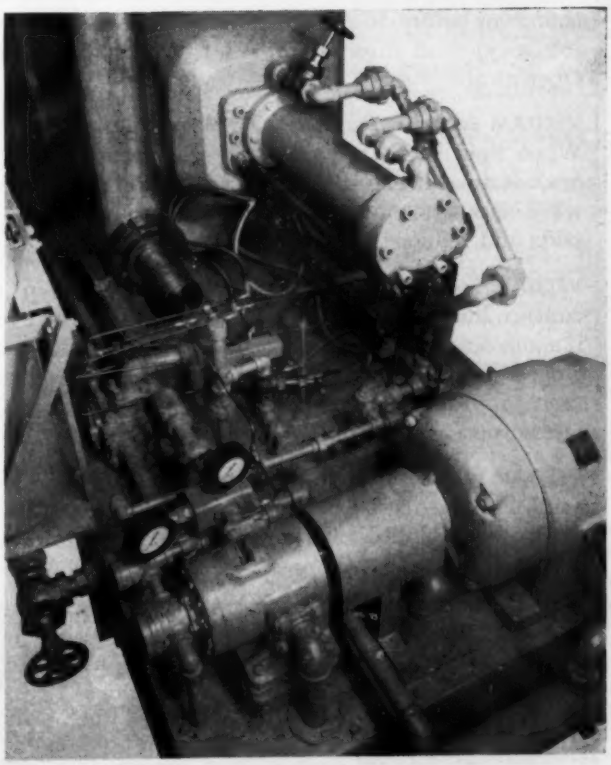
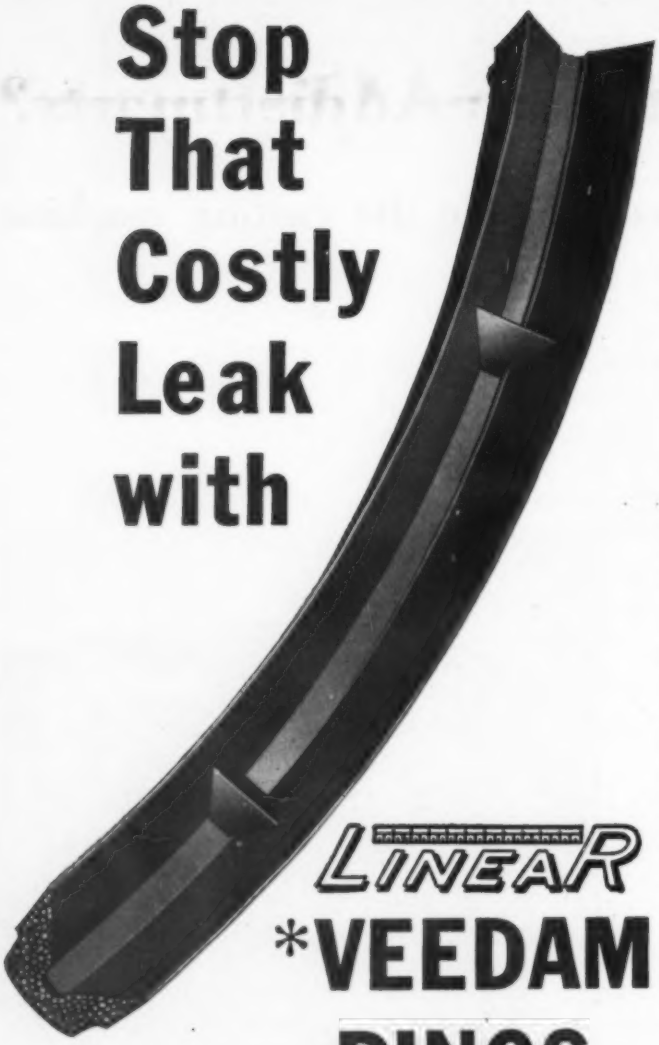


FIG. 3. Accessibility for maintenance is assured by putting the hydraulic components outside the frame of the die casting machine. Component layout must be carefully made to avoid interference as the cylinder position is changed.

# Stop That Costly Leak with



LINEAR *VEEDAM RINGS

Today, with materials and maintenance costs higher than ever before, Management is ever on the look-out for ways and means to effect savings in Plant Operations.

**VEEDAM Seals** are LINEAR'S answer to fluid leakage. When fluid leakage is stopped, still greater savings are obtained because of reduction of down-time, less work spoilage, no deterioration of rubber forming pads and reduced work hazards.

**VEEDAM Seals** are not only fluid-tight at the point of contact but they are also effective at the joint even if a gap occurs. If openings do occur in more than one ring, the sturdy abutments or dams at the hinge area provide positive, hermetic sealing against all lateral passage of fluid.

**VEEDAM** fabric reinforced seals have already been successfully field tested in the toughest of applications. Send for complete details on your company letterhead.

*Patent applied for

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.


# *Pioneers in Oil Hydraulics*

OIL hydraulics is a development of the 20th century, building on a long evolution of water hydraulics before it. In common with all developments, the initial impetus, progress and the direction of the progress was due to the work of the early leaders in this still relatively new industry.

When Dr. Samuel P. Langley, secretary of the Smithsonian Institute, was developing his man-carrying flying machine, he sought unsuccessfully for an engine that would develop 12 hp and would weigh between 220 and 330 pounds. Engine builders told him that such an engine was impossible. At the turn of the century, Langley was working on a special wartime assignment on a grant from Congress "to develop, construct and test a flying machine on a scale capable of carrying a man". He had come out of retirement and was serving without compensation. At the suggestion of R. H. Thurston, dean of the College of Engineering at Cornell University, he accepted Charles M. Manly to assist him, especially in the design and construction of a power plant for his aerodrome.

By December 1901 Manly had completed an engine, the first radial aircraft power plant. The engine developed 52.4 hp and weighed only 125 pounds, a weight ratio of 2.4. The Langley machine was successfully flown with this engine.

Manly in the meantime was working on a hydraulic drive to transmit the engine power to the twin propellers of an airplane. He took his first patent on a hydraulic variable speed power transmission in 1902. As developed commercially by the Manly Drive Company, of which Manly was vice president and chief engineer from 1906 to 1915, the Manly hydraulic drive consisted of a radial cylinder, variable stroke pump, a dual distribution and valving system and a radial, multiple cylinder, fixed stroke hydraulic motor. The entire drive was built as a single unit; the drive was rated by an independent organization as 87 percent efficient. Units with a "follow up" control system were applied to swing bridges, experimental passenger cars and trucks. LaFrance and Remington trucks were the major units equipped. For truck applications one hydraulic motor was provided for each driving wheel, eliminating the differential. Important marine applications were made, including sixty of the drives, adapted for controlling large guns in turrets in battleships built by the Bethlehem Steel Co. about 1911 for Argentina.

### *The Hele-Shaw Development*

On or about 1873 an English inventor patented a motor in which the pistons radiated from a central pintle, whose eccentricity could be changed. As far as is known, this was the first variable volume unit. It is not known if the unit was ever used industrially.

Perhaps the most important advance in the field was made by Dr. H. S. Hele-Shaw, a distinguished English inventor, who patented the first floating ring drive pump. The first pump and its companion fluid or hydraulic motor were designed as a transmission system for motor cars. The pump had 11 radial cylinders, driven at engine speed, about a single spindle that also served as a valve. The floating ring was mounted eccentrically to the axis of the working cylinders, the degree of eccentricity determining the stroke of the pump which could be varied at will.

The floating ring was the basis of the patent. Hele-Shaw design pumps were licensed and are still built in this country by the American Engineering Company. All principal builders of radial piston pumps still use the Hele-Shaw floating ring to actuate the piston.

The Hele-Shaw hydraulic motor had six radial cylinders and was a constant stroke type. Double cam tracks, developed by T. E. Beacham, an associate of Dr. Hele-Shaw, assured that an absolutely constant rate of oil supply and discharge is maintained, the shape providing very large lap for the valve ports, preventing oil loss by leakage or slip from suction to pressure side of the central spindle valve. The hydraulic motor, built as a separate unit, ran at considerably less speed than the pump and developed an efficiency of 95 percent.

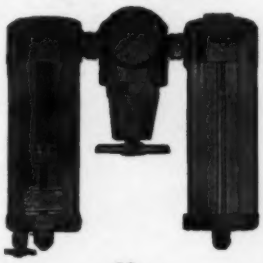
Beacham and Hele-Shaw also developed and patented another type of radial pump which has not been introduced into the United States.

Continued on page 119

Circle 91 on Reader Service Card

"M-B" AUTOMATIC
Air Line FILTER, REGULATOR and LUBRICATOR ASSEMBLY

"Sentinel of the Air Line"



Also Pneumatic Grinders

"Remember, Built-in quality remains long after first-cost disappears."

FILTER element removes solids .00039 and larger. TRANSPARENT BOWL provides visibility. REGULATOR is capable of passing large volume with an unrestricted flow and minimum amount of pressure drop. Self-bleeding, compact, simple. Machined from bare aluminum. LUBRICATOR delivers desired volume of oil. Adjustable Venturi Valve permits efficient operation on broad range of volume and pressure. Bowl can be refilled without shutting off air supply. Any of these 3 devices can be used as separate units or in any combination.

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DETROIT 3, MICHIGAN

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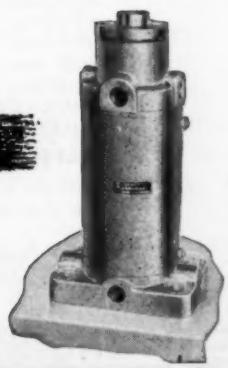
"LOGAN" HYDRAULIC CYLINDERS
SAVE TIME EFFORT MOTION

Here's fast-acting, positive controlled power for all types of industrial applications. . . .

LOGAN 750 SERIES

ROTATING TYPE—Seven standard sizes from 3" to 14" diameter bore. Larger sizes special to order. Maximum operating pressure 500 p.s.i.

NON-ROTATING TYPE—Eight standard sizes from 2" to 8" diameter bore. Larger sizes special to order. Maximum operating pressure 750 p.s.i.



LOGAN ROTOCAST® SERIES

7 STANDARD MOUNTINGS

Sizes from 2" to 8" bore; any length stroke up to 8 feet. Other bores and lengths are special. Four piston rod end types. Operating pressures to 1500 p.s.i.

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COLLET GRIP TUBE FITTINGS — CATALOG 44
HYDRAULIC CONTROL VALVES — CATALOG 200-4
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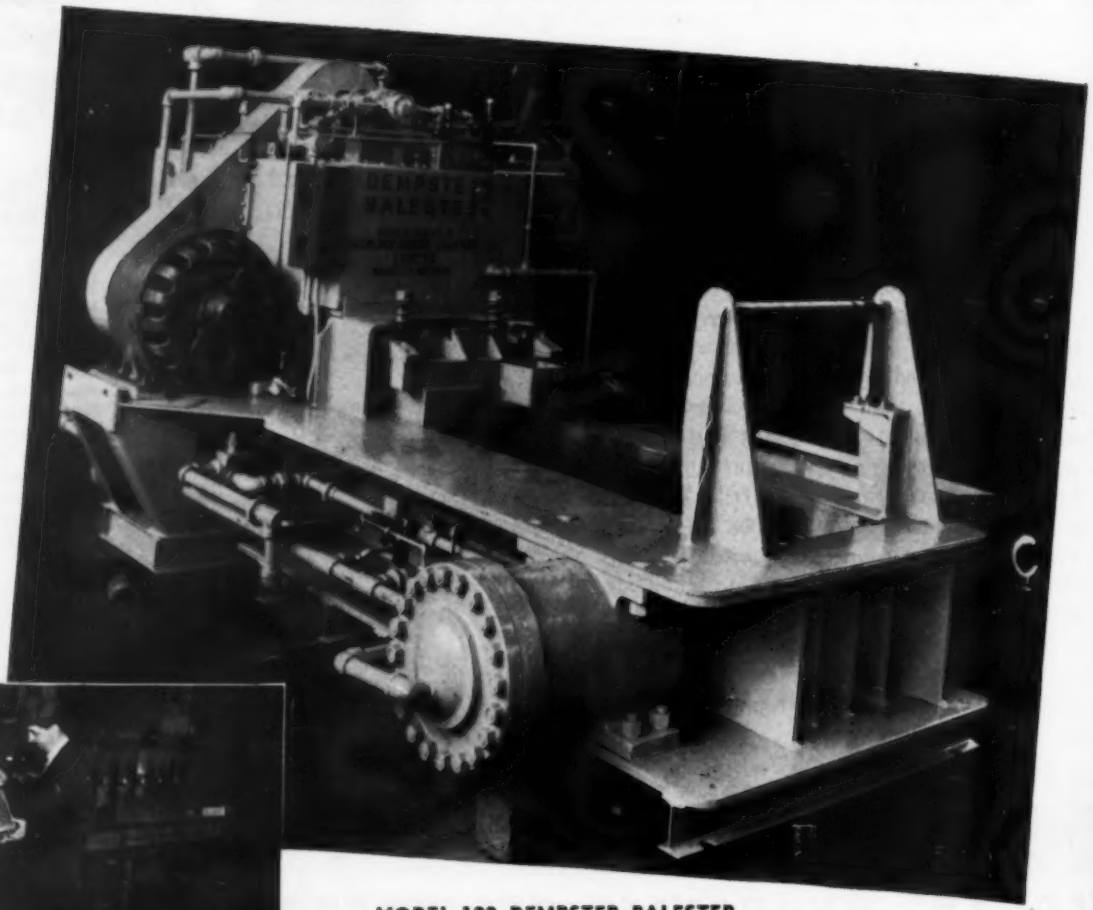
# ANOTHER MANUFACTURER SPECIFIES
# MARVEL SYNCLINAL FILTERS



At left, Mr. G. W. Jankowski, Chief Mechanical Engineer extolling the merits of Marvel Synclinal Filters to Mr. Archie Thompson, Supervising Erector of baling equipment.

**MODEL 128 DEMPSTER BALESTER.**

One of 4 different models manufactured by Hamilton Bridge Company. Used in baling non-ferrous sheet metal scrap, making bales ranging from 60 to 800 lbs. All are hydraulically operated throughout by Vickers Vane Pumps. Manufacturer reports: "We have installed Marvel Synclinal Filters exclusively in all the balers which we have manufactured, and they have been satisfactory in all cases."

(Photo's Courtesy Hamilton Bridge Company Ltd., Hamilton, Ontario, Canada)

Sump Type (cutaway)

Line Type (cutaway)

## COMPLETE—EFFICIENT FILTRATION IN ALL HYDRAULIC EQUIPMENT

Each day, more manufacturers and users of hydraulic machines and other equipment with low pressure, non-corrosive liquid systems are depending on Marvel Synclinal Filters to protect their machines efficiency. Marvel filters are available in sump and line types, in capacities from 5 to 100 g.p.m. and in monel mesh sizes from 30 to 200. Both may be easily disassembled, cleaned and reassembled by any workman. Line types operate in any position and may be serviced without disturbing pipe connections. Depend on Marvel Synclinal Filters for all of your filtration requirements.

**WATER FILTERS** In response to the great demand, we have adapted both our sump and line types for use in all water filtering applications. No changes have been made in the basic Synclinal design.

***Write for complete engineering data—specify oil or water***

**Meets J.I.C. Standards**

**MARVEL ENGINEERING COMPANY**
625 W. Jackson Blvd. Chicago 6, Ill.

# What's NEW in Components for fluid power systems

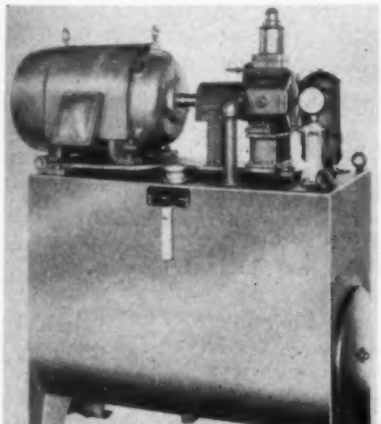
**For more information about these products use the postcard bound in this issue**

### Power Units

*Superdraulic Corporation*
*Detroit 4, Michigan*

**Sizes:** 30, 60 and 80 gallon standard sizes.

**Construction:** Built to J.I.C. standards with Superdraulic or any other make pump specified by the customer. In addition to pump, motor, valving, etc., the



design features such details as ample floor clearance, large tank cleanouts in both ends, sight gauges, filler and bleeder caps on both ends and oil filters. These units can be readily adapted to include special types of equipment to suit individual customer requirements.

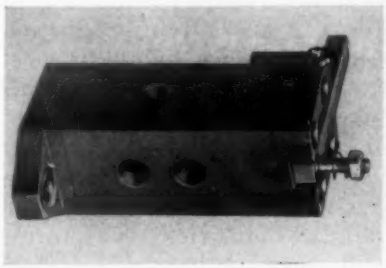
Circle 201 on Reader Service Card

### Air Operated Relay Valve

*Marton Air Equipment Ltd.*
*Richmond Surrey, England*

**Designation:** Type No. S 556/11. Lever operated bleed type relay valve.

**Features:** The main feature of this valve is its high sensitivity. The effort required to operate it



is approximately 2½ ozs. and the movement .010 inches. Repeat accuracy is .002 inches. Pressure on the lever opens the bleed, which is normally closed, and the resultant decrease in the air pressure operates the relay. The ports are tapped ⅛ inch B.S.P.

Circle 202 on Reader Service Card

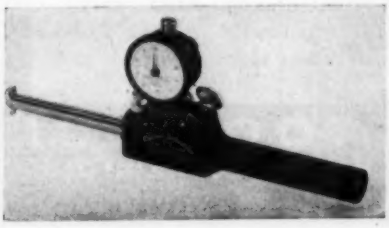
### "O" Ring Gauge

*Reliant Industries*
*South Gate, California*

**Designation:** Model B-100.

**Application:** Inspect internal "O" Ring grooves from ⅜ to 1⅞ inches. The gage is not limited to checking "O" Ring grooves. It can also be used for checking out of round—inside diameters—deep holes—recesses—taper.

**Operation:** Diameters are measured direct and are set directly to a master ring gage. A slight rocking motion in one direction quickly gives the minimum reading of the diameter on the indicator. All motion is transferred directly through a lever. With the use of a dial indicator graduated to .0001 inch, groove dimensions having very close tolerances can be positively and precisely inspected.

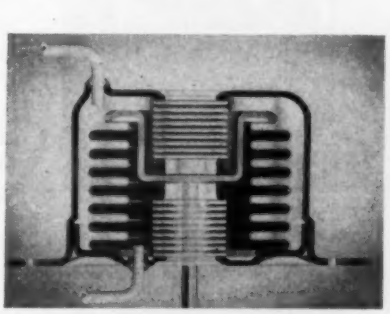


Circle 203 on Reader Service Card

### Bellows Assembly

*Clifford Manufacturing Company*
*Waltham, Mass.*

**Application:** Single unit bellows assembly for differential pressures. Used for thermostatic or pressure switches, which must not be effected by barometric changes due to altitude or other factors; used for flow indication or control. Pressure drop across an orifice or venturi can be used to sense flow in a closed system.



The new unit is recommended for all types of industrial processes in which the pressures within a closed system must be automatically equalized or where absolute pressure must be maintained.

**Operation:** Two different pressures are supplied to the opposite sides of the large bellows in

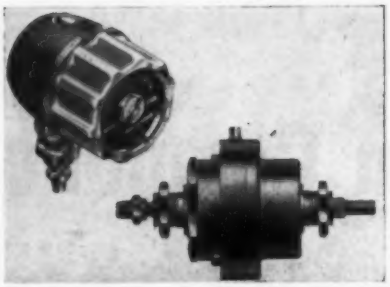
the center of the unit. One tube allows pressure to be exerted against the inside surface of the bellows, the second tube permits pressure to be applied to the outside surface. Since the pressures inside and outside the large bellows are acting on the same effective areas, the resultant force produced by the difference between the inside and outside pressures can be utilized through the center of the unit to actuate switches or valves or other controls. The two smaller bellows are used to seal the ends of the main bellows.

Circle 204 on Reader Service Card

### Positioning Control

*The Farris Hydrotorque Corp.*
*Palisades Park, N. J.*

**Designation:** Hydrotorque.
**Design:** A single tube system independent of outside energy. Eliminating sponginess, the control system gives the operator the feel of direct linkage, with the confidence of positioning within a thousandth of an inch.



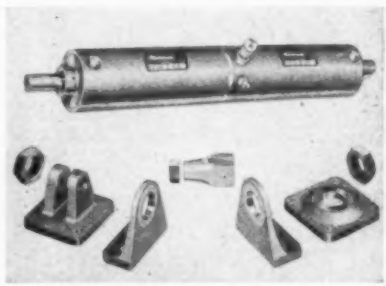
Extremely flexible, the transmitters and receivers can be supplied in a wide variety of combinations and in many variations of mounting methods. Calibration of dials is to custom requirements and can be made to read in inches of water, pounds of pressure, gallons per minute, up-down or any given designation.
**Application:** A hydraulic positioning control system designed for extreme accuracy and power at remote distance. Designed for use in the aircraft, marine, industrial, refinery, chemical and railroad industries, Hydrotorque will hydraulically position valves, throttles, engine speeds and other mechanical devices.

Circle 205 on Reader Service Card

### Air Hydraulic Cylinder

*Modernair Corporation*
*San Leandro, California*

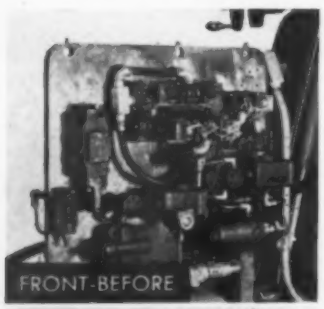
**Sizes:** Two bore sizes are presently available as standard, 2 and 3 inch.
**Design:** This cylinder features interchangeable mounting brackets. Standard shop airline pressure is utilized to actuate the cylinder, while the built-in hydraulic system furnishes positive regulation of forward or reverse stroke movement by adjustment of speed control.

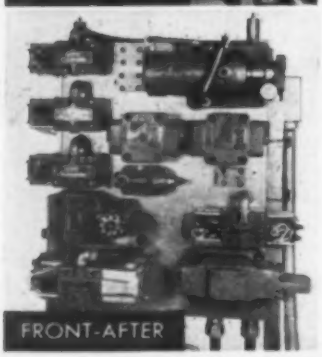


**Application:** Cylinder is ideal for powering tools or work in machining operations, to permit rapid traverse (if skip feed bypass is used), finely controlled

Continued on page 110


# HOW TO MODERNIZE HYDRAULIC INSTALLATIONS

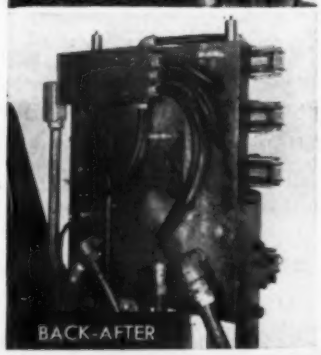



These "before" and "after" pictures of the hydraulic installation used by The Gear Grinding Machine Company of Detroit in one of their units illustrates the simplicity, and therefore the efficiency, that has been achieved by the use of ALMO hydraulic manifolds. Designed by ALMO in cooperation with GGM engineers, the manifold replaces the original control panel. Since all fluid passages are internal, the new installation saves space and eliminates the cumbersome maze of tubing.

Eliminated, also, are the scores of fittings and connections which are potential sources of trouble. Maintenance and down-time are reduced to an absolute minimum. Yet the streamlined, modern, efficient installation is *less expensive by far* than the original.

Manufacturers of hydraulically operated machines are invited to investigate the ALMO method of modernizing their products, at less cost, and with the assurance of greater user satisfaction.




ALMO TOOL COMPANY
HYDRAULIC MANIFOLDS
3327 East Vernor Highway Detroit 7, Michigan

Circle 9 on Reader Service Card

## Centennial of Engineering Notes

IN addition to the special features of the Centennial of Engineering (see pages 48 and 63), the American Society of Mechanical Engineers and the host society, the American Society of Civil Engineers, among others, will hold full scale technical sessions.

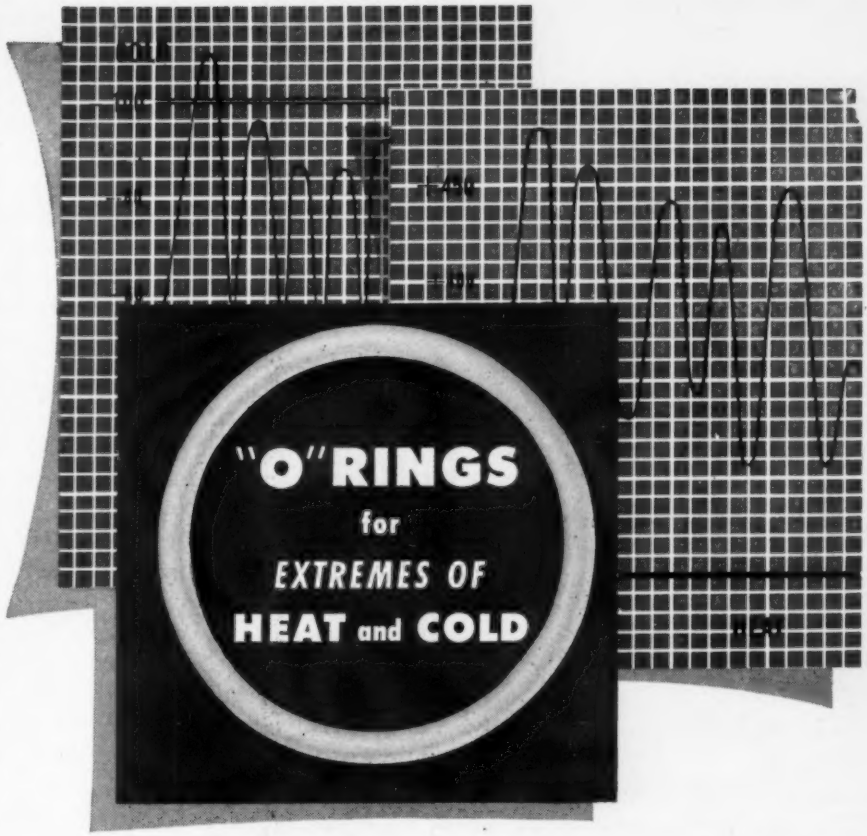
The American Society of Mechanical Engineers will hold their regular fall meeting in Chicago at Hotel Sheraton, September 8-11. A program of 37 sessions, at which 97 papers will be presented, has been announced. Papers describing developments in nuclear energy, rubber and plastics, hydraulics, petroleum, safety and machine design, production engineering, gas turbines, machine design, heat transfer, materials handling, applied mechanics, rocketry and wood industries will be given.

In addition to the technical papers, R. J. S. Pigott, president of ASME, will address the International Presidents' Luncheon on the subject "What is Not Yet, May Be!"; Col. Lyndall F. Urwick of London will deliver the Calvin W. Rice Lecture on "Management's Debt to the Engineer"; and Senator Ralph E. Flanders, of Vermont, past president and honorary member of ASME, will deliver the Row V. Wright Lecture on the subject, "Engineering and Politics".

The host society will hold a reception for foreign delegates on September 3; significant ceremonies will be held on September 10, designated as Centennial Day. A special luncheon and all-inclusive evening party will be held.

The tremendous volume of work incident to the Centennial has been handled by two committees representing each of the participating societies. The Coordinating Committee on Technical Programs, under the chairmanship of G. Donald Kennedy, assistant to the president of the Portland Cement Association and the Committee on General Arrangements, under the chairmanship of Howard F. Peckworth, managing director of the American Concrete Pipe Association, have promised an outstanding program.

Exceptional opportunities for sightseeing and entertainment are provided by Chicago and numerous tours have been arranged.


**SILICONE "O" RINGS PERFORM OVER A W—I—D—E TEMPERATURE RANGE!**

Avoid premature seal failures by selecting the proper "O" Ring materials. For "O" Ring applications that encounter temperature extremes as low as −110°F or as high as +480°F, the use of silicone "O" Rings is indicated. Silicone "O" Rings also provide excellent resistance to chemicals . . . weathering . . . oxidation and moisture. If you have an application requiring "O" Rings to maintain a seal for long periods at either very low or high temperatures, it will pay you to investigate the many properties of silicone rubber. All dash numbers of 6227, 6230 and 6290 series for industrial applications or Army-Navy installations to Specifications MIL-P-5516 (6227 and 6230) and MIL-G-5510 (6290) are available from stock. Silastics and other special compounds are available on order.

*Catalog and engineering data on request. Write us today.*

Parco

**PLASTIC AND RUBBER PRODUCTS CO.**

*2100 Hyde Park Boulevard, Los Angeles 47, California*
*820 North State Street, Chicago, Illinois*

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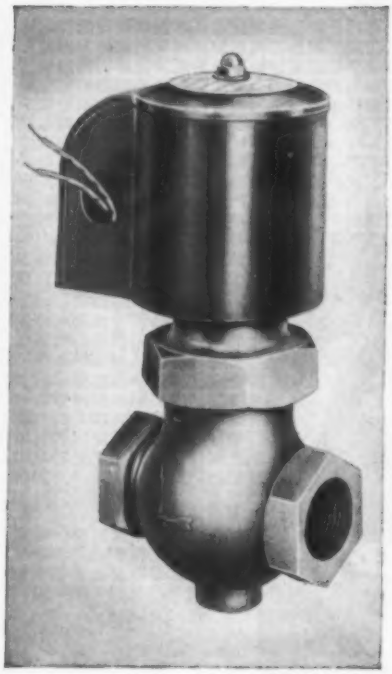
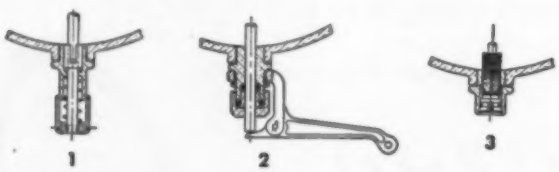


**Bulletin 8210**

**General Purpose Control Valves**

★ **Full Port Area—Packless**
★ **For Air, Gas, Water, Brine, Freon, Methyl Chloride, Light Oil and other Liquids and Gases up to 212°F; Pressures up to 400 pounds**
★ **Several Auxiliary Variations**
★ **Several Sizes: ½ to 2½ inches**

Our Bulletin 8210 Solenoid Valves are designed for those shut-off requirements where a simple, rugged, automatic control will serve. They close instantly when current to the coil is cut off. Full line pressure on top of the valve piston aided by a powerful spring assures tight closing. They reopen fully when the coil energy is restored. Only minimum current is required because the solenoid, when energized, is required to open only the small pilot port against the line pressure. The construction is such that the valve is held open by the solenoid for full pipe area independent of the flow through the pipe line.




Three auxiliary variables are available: (1) device for locking the valve in open position; (2) device for utilizing the valve for whistle control; (3) by-pass adjustment for holding the valve open.

Bulletin 8211 Valves are similar except that they have Explosion-Proof Solenoids approved by Underwriters' Inc., Class 1, Group D, Hazardous Location.

If you have any automatic control problems that fit into the above class, you might study fully the merits of Asco Bulletin 8210 and 8211 Solenoid Valves. Write us anyway, regardless of your problems, because we have many other types of solenoid valves.

ASCO Solenoid VALVES

V.51.1

When in need of Electromagnetic Controls, come to us.

**Automatic Switch Co.**
**385H LAKESIDE AVENUE • ORANGE, NEW JERSEY**

# Coil Unpeeler

Concluded from page 67

this pressure during the operation of the swing cylinders or chisel cylinder.

Control of the peeler chisel blade is accomplished with a hydraulically counterbalanced swing cylinder arrangement. The swing cylinders are operated by a special four-way lever operated valve (4) so arranged that when pressure is directed to the blank end of the cylinders to swing the chisel into position, pressure is also directed to the spring chamber of the sequence valve, holding this valve closed to prevent oil from escaping from the rod end of the chisel cylinder. When the lever on the valve (4) is moved to the extreme out position, pressure is directed to the rod end of the piston to force the piston up. When the lever of this same valve is in the center position, the head end of the cylinder is connected to the tank, and rod end is connected to the tank through the check valve which will permit the piston of the cylinder to move up mechanically by a force externally applied.

### *Floating Swing Cylinders*

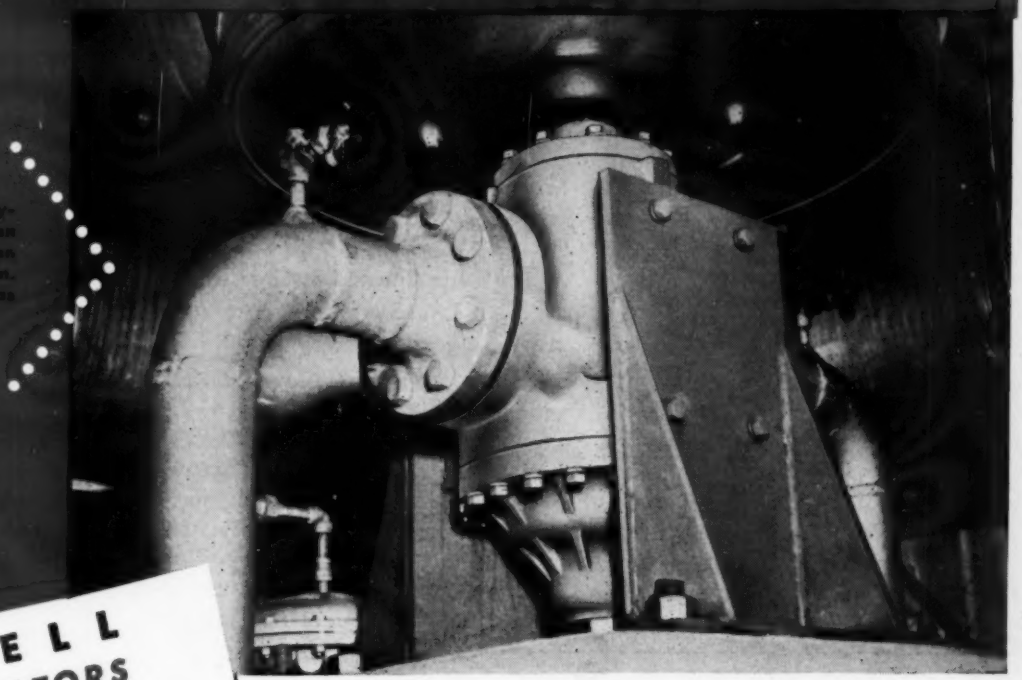
The chisel cylinder is operated by the four-way lever operated valve (5). When the lever is in the extreme out position, the pressure is directed to the blank end of the cylinder, forcing the chisel down to open the coil. Having completed its stroke, the lever is moved to the extreme in position and pressure is directed to the rod end of the cylinder through the sequence valve, so that the chisel moves to the extreme up position and then pressure is directed through the secondary outlet to the rod end of the swing cylinders. When the handle is in the central position, all ports are blocked.

Counterbalance valves are used to prevent dropping of the chisel cylinder or movement of the swing cylinders, except when pressure is applied to the piston ends. Safe operation is assured by the sequence and counterbalance valves. Use of the sequence valve prevents the swing cylinders from moving the chisel until the chisel is raised clear of the coil. As the chisel moves down during the peeling operation, the floating feature permits movement of the swing cylinders by external force so that the chisel may find its proper position.

Following the material in Figure 2: from the peeler the coil is mounted on a mandrel at the entry end of the processing uncoiler. Here hot rolled material is opened without cross break, also when this unit is used on a pickling line scale formations are broken which helps to reduce pickling costs. The uncoiled strip passes through a hump table loop, Figure 2, and then into the adjustable housing side trimmer. In this unit the material is trimmed to exact width and the scrap is deflected downwards into a scrap chopper. The strip proceeds from this point to a flying shear and passes from that unit over a belt conveyor through a roller leveler and into a prime and reject piling unit.

YOU DON'T NEED A HIGH PRESSURE SYSTEM

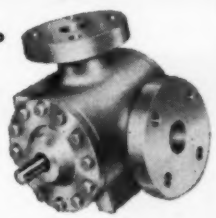
# to get HIGH HORSEPOWER and HIGH TORQUE AT LOW SPEEDS

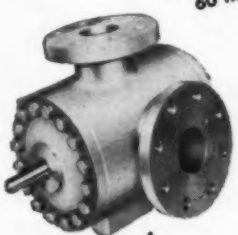


No. 5 Rockwell Rotocycle hydraulic motor directly driving an 8 ft. diameter forced draught fan at rates of from 0 to 300 r.p.m. on jacket water cooler in gas compressor station.

## ROCKWELL ROTOCYCLE MOTORS

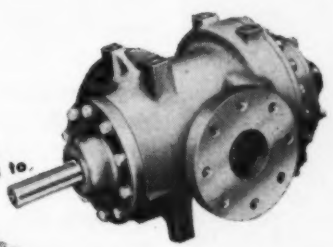
MODEL NO. 2
Torque range 31 to 60 in. lbs.*

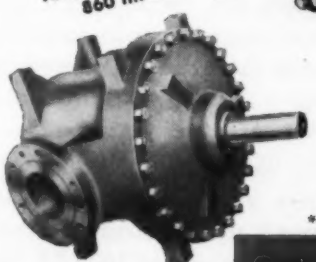




MODEL NO. 4
Torque range 134 to 268 in. lbs.*

MODEL NO. 5
Torque range 318 to 860 in. lbs.*





MODEL No. 8
Torque range 1800 to 3600 in. lbs.*

*Above torque ratings at 100 psi

Because of low operating pressure you don't require special high pressure valves and fittings when you install Rockwell Hydraulic Drives. Leaks, breaks and hazards are eliminated. Further, a low pressure system costs less both initially and to maintain.

Engineered applications of Rockwell Hydraulic Drives are now available for centrifuges, fin fans, diffusers, agitators, extruders—in fact any service where variable speed flexibility with safety is required. Write today for engineering counsel on your proposed application.

**HYDRAULICS DIVISION**
**ROCKWELL MANUFACTURING COMPANY**
400 N. Lexington Ave. Pittsburgh 8, Pa.

ROCKWELL

## ROCKWELL HYDRAULIC DRIVES

Ratings from fractional to 300 h.p., with maximum torque at start

Continued from page 106

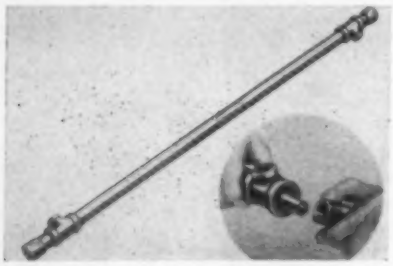
movement during work operation, and fast reverse action. Flush exterior permit installation in restricted space. The hydraulic control insures smooth action each and every cycle.

Circle 206 on Reader Service Card

### After-Cooler

*The Heat-X-Changer Co.*
*Brewster, N. Y.*

**Design:** Compact unit features longitudinal fins which provide maximum heat transfer with minimum air pressure drop.



Tubing and longitudinal fins in the after-cooler are copper, readily removable for cleaning or replacement. Other design features include synthetic rubber "O" rings which make a positive seal between air and water (thus eliminating all soldered and packed joints), low volume cooling water requirement, and an efficiency of operation which will cool the air to within 10 degrees of the water supply temperature.

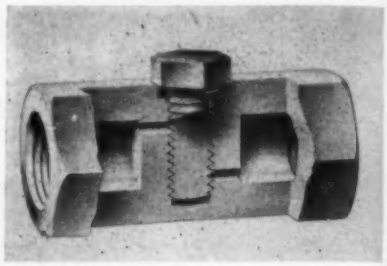
**Application:** Removal of oil and moisture from compressed air systems from 1 hp to 15 hp. Use of the water-cooled after-cooler will protect pipe lines against rust and corrosion, protect air instruments against fouling, eliminate freezing of water in pipelines and air tools and prevent receiver tank explosions.

Circle 207 on Reader Service Card

### Air Flow Snubber

*King Engineering Corporation*
*Ann Arbor, Michigan*

**Size:** The snubber is 1⅞ inches long by 1⅛ inches maximum over all, and is made of hexagonal brass rod throughout except for a neoprene O-ring used to seal the snubbing screw. Inlet and outlet ends are tapped for ¼ inch pipe. Flow rate is approx. 0.04 cubic feet per minute at a pressure drop of 70 pound per square inch; and maximum operating pressure is 1000 psi.

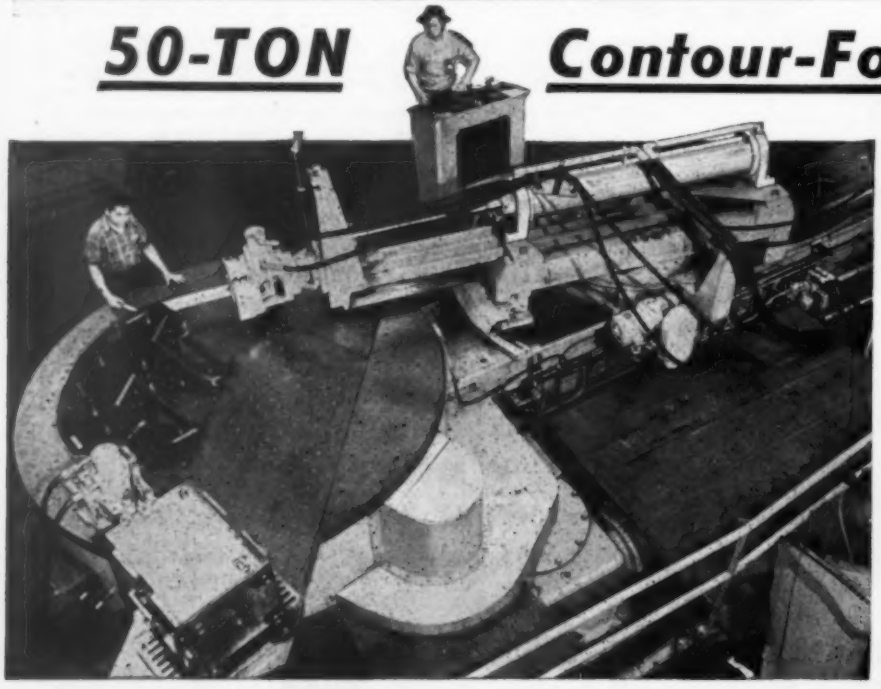


**Operation:** The snubbing action is accomplished by passing the air or gas through a helical restricting passage (nearly 7 inches long) around the threads of a screw at right angles to the snubber body. With normally clean air or gas, this restricting passage remains clear indefinitely. If plugged eventually by dirt or moisture, the snubber is quickly put back in operation by removing and cleaning the snubbing screw, without disconnecting from the line.

**Application:** Provides a controlled slow rate of flow of compressed air or gas for operation of continuous-reading hydrostat-

Concluded on page 114


**50-TON Contour-Former employs GIANT NOPAK Cylinder**



**Built by the Cyril Bath Co., Cleveland O., this powerful machine is used to shape curved aluminum airplane fuselage parts. A NOPAK Model "A" 10" x 80" Hydraulic Cylinder . . . operating at 1500 P.S.I. . . . works in conjunction with the forming die, mounted on a gear-driven turntable, to stretch-form an infinite number of curved structurals . . . with 700 different dies now in use.**

**Very likely the efficiency of machines you build or use can be stepped up substantially through the correct use of NOPAK Valves and Cylinders.**

**GALLAND-HENNING MFG. CO.**
**2743 S. 31st St., Milwaukee 46, Wisconsin**

*Representatives in Principal Cities*

Refer to Sweet's File for Product Designers or write for Bulletin SW-1

**NOPAK**
**VALVES AND CYLINDERS**
**DESIGNED for AIR and HYDRAULIC SERVICE**

When sirens scream and fire trucks roar through the streets to battle a blaze caused by a hydraulic line breaking in your die-casting plant, it's *too late.* Too late to prevent a fire. Too late to save lost production due to machinery and building damage. Too late, perhaps, to prevent injury or death to employes.

You can reduce the possibilities of such a disaster by switching to Monsanto Pydraul F-9 . . . *now.* You can change to Pydraul F-9 simply by draining the hydraulic system and refilling with the Monsanto product.

Pydraul F-9 is Monsanto's nonflammable-type hydraulic fluid. Under test conditions, it does not flash or ignite when sprayed, dripped or flooded on molten metal heated to approximately 1,500° F., nor does it ignite or flash when sprayed, at 1,000 p.s.i., into the 6,000° zone of an oxyacetylene flame. Users say Pydraul F-9 has prevented fires in their plants.

In addition to increased *safety*, you get *efficiency* and *economy* when you switch to Pydraul F-9. The fluid has high resistance to mechanical shear and chemical breakdown. It is high in lubricity and does not corrode metals from which machines are constructed.

Investigate the increased safety, efficiency and economy of Monsanto Pydraul F-9 today. Contact the nearest Monsanto Sales Office or write for a copy of the 12-page, file-size booklet, "Pydraul F-9." MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle, Twin Cities. In Canada, Monsanto Canada Limited, Montreal.

*Pydraul: Reg. U. S. Pat. Off.*

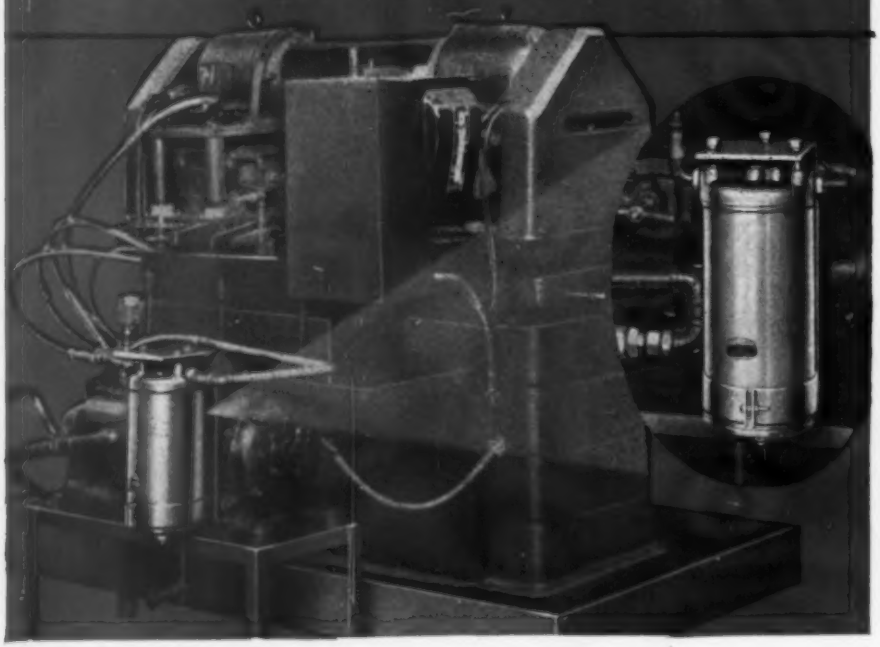
**PYDRAUL F-9**

MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

# NOVI EQUIPMENT CO. CHOOSES GENERAL FILTERS

## . . . for Low Cost Protection of their Hydraulic Systems



As protection for the all-important hydraulic control units on their EX-CELL-O Grinders Novi Equipment Co., of Novi, Mich., relies on the GENERAL AF-500 FILTER. The AF-500's positive absorption seals off hydraulic and lubricating system impurities from highly machined vital parts, removes moisture, eliminates the necessity of draining and refilling oil systems for as long as a year. Clean, safe oils are assured at 15-20 gallons per minute, depending upon viscosity. This trend toward GENERAL is industry-wide. Both on new and old equipment, General Industrial Filters reduce maintenance costs and offer the longer machine life required by current production schedules.

*Here are the Facts:*

1. Traps particles as fine as 5 microns.
2. Two-fold filter element — finest all-wool cartridge supported by a wire mesh screen.
3. Removable cartridge allows quick, simple cleaning in any suitable solvent. No need to disconnect any lines.
4. Install with inlet at top or bottom — whichever best fits your space and piping requirements.

FILL OUT AND MAIL FOR COMPLETE SPECIFICATIONS AND PRICES

YOUR NAME_____

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*Remember* WE'RE PREPARED TO ADVISE YOU FREE OF CHARGE ON FILTERING PROBLEMS

**GENERAL FILTERS, INC.**

12890 WESTWOOD • DETROIT 23, MICH.

CANADIAN GENERAL FILTERS, LTD., 2679 DANFORTH AVE., TORONTO 13, ONTARIO


## Advisory Group Named For Plant Maintenance Show and Conference

A twelve man group of industry executives, principally advertising and sales heads, has been chosen for the advisory board of the Plant Maintenance Show and Conference, to be held at the Public Auditorium, Cleveland, Jan. 19 to 22.

Both show and conference have been planned on a scale never before attempted in the maintenance field. Three hundred and fifty companies are expected to conduct exhibits, with some displays scheduled to be larger than 3,000 square feet.

The conference, too, will undergo a huge expansion. More than 60 separate sessions are planned. Virtually every industry will have its maintenance problems discussed in separate sessions, in addition to panels devoted to the maintenance policies of top management.

On the advisory committee are D. F. Beard, Reynolds Metals Co.; I. K. Byrne, Complete-Reading Electric Co., Inc.; C. J. Copley, Socony-Vacuum Oil Co., Inc.; S. W. Corbin, General Electric Co.; Howard F. Eastwood, Barreled Sunlight Paint Co.; William Flatow, Jr., West Disinfecting Co.; Orville C. Hogander, G. H. Tennant Co.; H. R. Meyer, Westinghouse Electric Corp.; W. L. Parcell, Ridge Tool Co.; Francis S. Russell. RCS Tool Sales Corp., and Stuart C. Sommer, James G. Biddle Co.

## New Home For Fulflo Filters

During July, Commercial Filters Corporation, manufacturers of Fulflo filters, moved from Boston to its new factory in Melrose, Massachusetts.

In every aspect the new plant has been carefully planned to provide every advantage afforded by the most recently developed types of construction and equipment.

The plant consists of three buildings with total area of 135,000 feet. Special features include: glass-block side walls; perimeter hot water heat and radiant heat floor panels in manufacturing areas; automatically controlled forced air winter heating and summer cooling and fluorescent lighting. Manufacturing areas used for processing have controlled humidity.

Instant Automatic Flow and Shut-Off

Quick Connection and Disconnection

# WHY *Genuine* HANSEN COUPLINGS GIVE BETTER SERVICE LAST LONGER

LEAK-PROOF, Minimum Wear Locking Device

Integral Factory-Assembled Tamper-Proof Socket Head

## PICK GENUINE HANSEN COUPLINGS FOR HANSEN PERFORMANCE...

Locking pins in Hansen Push-Tite Coupling Socket afford large area contact with plug, thereby preventing wear and subsequent leakage.

**QUICK CONNECTIVE FLUID LINE COUPLINGS** *for*
**AIR • OIL • GREASE • HYDRAULIC FLUIDS**
**WATER•VACUUM•STEAM•OXYGEN•ACETYLENE**
**REFRIGERANTS • GASOLINE • COOLANTS**

**SINCE 1915**

● The ability of Hansen Push-Tite Couplings to withstand severe service—with practically no maintenance—has been thoroughly proved by years of hard everyday use in thousands of plants. The "socket head", which contains the locking device, is factory assembled into a rugged integral unit which cannot be readily injured or have component parts lost by casual tampering.

To connect the coupling, you merely push the plug into the socket with one hand. Flow is instantaneous. To disconnect, push back sleeve on socket—coupling disconnects. Flow is shut off instantly and automatically.

*Write for catalog giving complete range of types and sizes.*

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Export Department: CLEVELAND

## THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

Concluded from page 110

ic instrument and for purging pneumatic instrument lines. It also protects pneumatic testing and gaging equipment against damage that might result from surge pressures, by providing a flow restriction in the line. The snubber is also used as a pulsation damper for pressure gages, recorders, manometers, and similar instruments. Placed in the line between the instrument and the pressure source, the snubber damps or smooths out pulsations so that the instrument gives a steady reading.

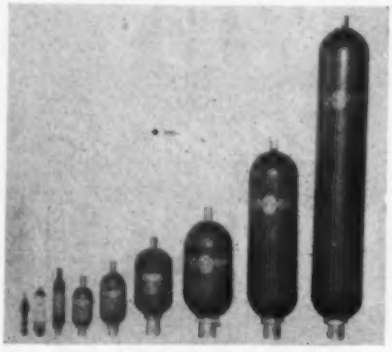
Circle 208 on Reader Service Card

### Air Bottles

*Greer Hydraulics, Inc.*
*Brooklyn, N. Y.*

**Sizes:** Capacities from 33 cubic inches up to 10 gallons. The company has the facilities for manufacturing smaller air bottles with capacities of 2½ gallons, 1 gallon, 1 quart and 1 pint.

**Specifications:** The guaranteed operating pressure of the air bottle, whether for use on the ground, or in flight, is 3000 psi. It has been shop tested at 8500-10,000 psi and burst tested at 10,000 psi. The air bottle is made of seamless, chrome molybdenum steel, specially heat treated to develop very high burst strength of 17,000 pounds for 3000 psi and up to 24,000 for 6000 psi. It is also non-shatterable.



**Application:** The air bottle is utilized for ground and airborne operations. When used for airborne purposes in the pneumatic system, the air bottle is usually sperical in shape for lighter weight.

### Flexible Couplings

*Cone-Drive Gears Division,*
*Michigan Tool Company*
*Detroit, Michigan*

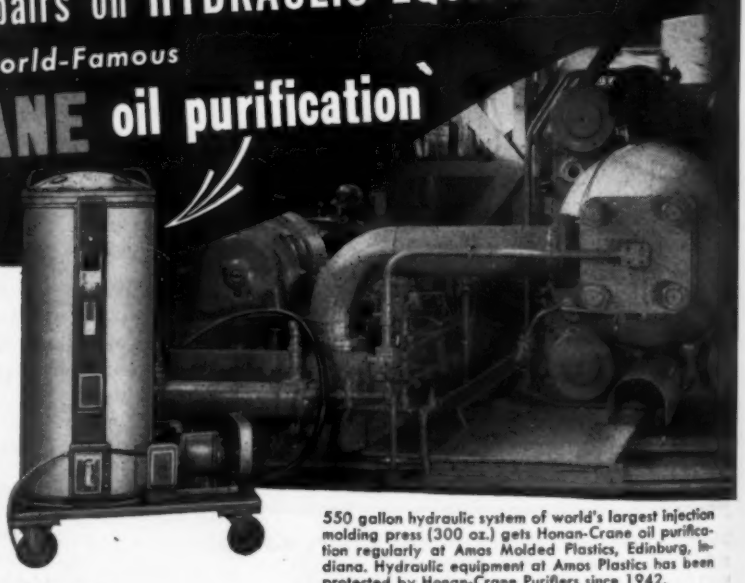
**Designation:** Cone-Drive Standard Bore Coupling.

**Design:** Gear Type with seven parts: a sleeve, two hubs, two neoprene seals and two snap rings. This design is easily disassembled and is sealed to keep weather out and lubrication in. The hubs and sleeve are SAE 1045 steel forgings with 90,000 psi tensile strength. The couplings allow an average of 3 degrees angular misalignment and 1/16 inch offset depending on size.

**Sizes:** The standard couplings are made in 22 bore sizes from ¾ inch to 6½ inches diameter with capacities from 4 to 550 hp. Other designs, including mill motor, spacer, vertical shaft and floating shaft types can also be had in a variety of bore sizes from ⅜ inch to 6⅝ inches diameter.

Circle 209 on Reader Service Card


STOP downtime, costly repairs on HYDRAULIC EQUIPMENT
with World-Famous
HONAN-CRANE oil purification

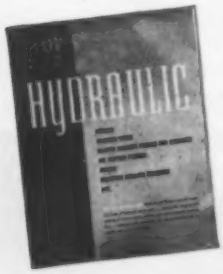


550 gallon hydraulic system of world's largest injection molding press (300 oz.) gets Honan-Crane oil purification regularly at Amos Molded Plastics, Edinburg, Indiana. Hydraulic equipment at Amos Plastics has been protected by Honan-Crane Purifiers since 1942.

**70% OF TROUBLE ON HYDRAULIC EQUIPMENT IS CAUSED BY OIL CONTAMINATION AND FAILURE**

Honan-Crane Purifiers prevent trouble before it starts in hydraulic installations by keeping oil clean and free from damaging contamination. When used to replace ineffective methods or where no purification program has been practiced previously, 50% reduction in hydraulic maintenance costs and 4 to 5 times the former safe oil life are common experiences.

Honan-Crane Purifiers prevent excessive wear of hydraulic pump parts . . . prevent clogging and sticking of control valves, pistons and other hydraulic mechanisms . . . greatly extend the safe-use life of hydraulic oils. Specify Honan-Crane Oil Purification for your hydraulic equipment. Proven by years of dependable service throughout the world . . . there's no reason to settle for less!




**FREE!** 8-page "Hydraulic Bulletin" with case histories describing profitable advantages of Honan-Crane Purification in many critical hydraulic applications. Write for your copy!

All Honan-Crane equipment is sold on a performance guaranteed basis

Honan-Crane Corporation
102 Wabash Avenue, Lebanon, Indiana
A Subsidiary of
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WORLD'S LEADING OIL FILTER MANUFACTURER

Circle 66 on Reader Service Card

## WANT HELP?

# Give us your power cylinder problems!

●The engineers of Anker-Holth have a vast fund of cylinder "know-how." Their background of experience covers the application of cylinder power to machines and equipment of many types and sizes. They are continually working with design engineers to develop the most efficient answers to power motion problems . . . air and hydraulic.

These cylinder specialists . . . backed by the modern manufacturing facilities of Anker-Holth . . . are at your service to make sure you get the *right* power cylinder *for your specific problem* For help, call today or write *Anker-Holth Division of The Wellman Engineering Company, 2729 Conner Street, Port Huron, Michigan.*

Anker-Holth manufactures hydraulic and air-operated cylinders in a wide range of sizes and types for push, pull, lift or lowering action. Shown above are Anker-Holth air cylinders. The one held in the hand has a 3-inch bore; the large one has a 24-inch bore and 36-inch stroke.

**Anker-Holth**

*ENGINEERED CYLINDER POWER*

WELLMAN

**Division of THE WELLMAN ENGINEERING COMPANY**



Circle 13 on Reader Service Card

# "Tycol Acylkup boosts bearing life... smooths the way for heavier loads"

Of course! Tycol Acylkup Bearing Grease "stays put" . . . keeps anti-friction bearings running smooth and cool. Finest quality neutral oils give it high load-carrying capacities. Tycol Acylkup is firmly resistant to the washing action of water. Its dependable lubricating abilities lengthen bearing life and reduce maintenance costs. Call your nearest Tide Water Associated office for further information.

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**TIDE WATER ASSOCIATED OIL COMPANY**

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**SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"**

# Aircraft Pneumatic System Elements

Continued from page 84

is not possible to provide a drive running at this speed, a reduction gear forming part of the compressor can be introduced.

In order to cater for installations where no cooling air stream is available, a compressor is being developed with an integral cooling fan; although this has the effect of increasing the cost and complexity of the unit, the ease with which it may be installed without regard to cooling aid ducts is greatly in its favor.

It is anticipated that air at pressures up to at least 150 psi at ground level will be available from turbine engines for supercharging high pressure compressors. Advantage will be taken to increase generating pressures and also to obtain much greater outputs than are currently available on normally aspirated compressors.

Investigations into a number of aircraft systems have shown that the optimum operating pressure in a 3000 psi storage system is between 1250 and 1500 psi. While there is no great difficulty in making pneumatic rams to work at higher pressures, the size and weight of storage bottles increases as the operating pressure increases, due to the fact that the expansive properties of air are not being utilized. In cases where space limitations are acute, it has been found necessary to have a mixed pressure system, in which case those rams which must be fitted into a limited space are working at almost storage pressure, while the others are operating at 1250 psi.

### *Air Motors*

Up to the present, turbine engine designers have been most reluctant to allow air to be bled from their engine in order to drive or cool accessories. It is believed that in future the engine designer will set out to provide sufficient excess air for the operation of auxiliary services. This will enable the high pressure compressor designer to utilize turbine air for supercharging his compressor as well as for driving it by means of an air motor. As the storage bottles in an aircraft pneumatic system are normally fully charged before take-off, the high pressure compressor would not be running until shortly after take-off and the turbine engine would not be robbed of any power at this critical time. The low temperature air stream issuing from the air motor could be usefully employed for cooling a high pressure compressure.

There is, of course, a vast field for small air motors using low pressure air for controlling many of the services on turbine engines; it is likely that in the immediate future numerous applications will be found for a very small high speed air motor using high temperature, low pressure air direct from the turbine engine. It has been shown that such air motors are much lighter than the corresponding electric motors


**Bendix-Skinner**

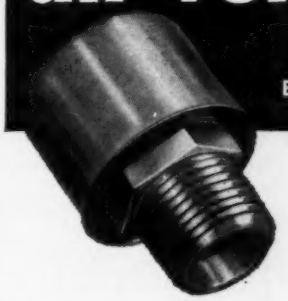
ORIGINATOR OF **MICRONIC** FILTRATION

offers NEW

*Ribbon*

air vent filters

IN SIZES FOR EVERY APPLICATION

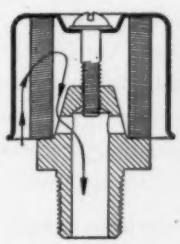


This compact, new ribbon element filter is available *for the first time* in three sizes—¼", ½", ¾" pipe thread, thus meeting the needs of every application.

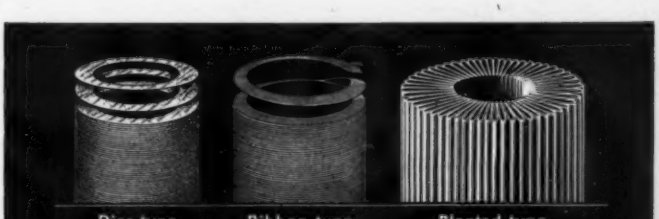
**Positive Controlled Filtration.** The specially designed element offers *greater efficiency than any air vent filter on the market*—approximately 40 micron filtration (.0016").

**Lasts as Long as the Equipment.** Although it costs little more than a quart of oil, *this ingenious filter will never wear out* . . . and is easily cleaned.

**Hundreds of Uses.** The new ***Bendix-Skinner*** Air Vent Filter has literally hundreds of applications. For example, hydraulic systems . . . air compressor intake . . . carburetor intake for small gasoline engines . . . crankcase ventilation . . . pneumatic cylinders . . . fuel tank breather . . . pneumatic instruments . . . immersion or sump filter.



***Write Dept. B for complete details on this revolutionary new filter.***



Disc-type Ribbon-type Pleated-type

*SKINNER PURIFIERS DIVISION OF*

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and have the advantage that they can be designed to withstand very high temperatures. It remains to be seen whether air motors can be successfully applied to undercarriage and flap actuators. However, the outlook is promising and there are many potential applications for compressed air which have not yet been explored.

It will be seen from this brief presentation that the scope of pneumatics is extremely wide and a great many current applications have not been mentioned. These include the operation of Anti-G suits from the high pressure pneumatic system, the inflation of door seals and the pressurization of fuel tanks. Even powered flying controls are within the bounds of possibility, although much work will be required in this direction before a practical system is evolved.

# Basic Pneumatics

Concluded from page 94

isothermal base, the overall and compression efficiencies for the adiabatic base are higher than those for the isothermal base for the same compressor under a given set of conditions.

### *Slippage Efficiency*

Slippage efficiency is the ratio of air actually measured to the apparent volume shown by an indicator diagram. Or, more simply, slippage efficiency is the ratio of the true and the indicated volumetric efficiencies.

This relationship of actual to the apparent volume can be made clear by an illustration. Where air flow can be measured, e.g., where a low pressure nozzle test* can be made, the actual or true volumetric efficiency may be determined. Let us assume that the low pressure piston displacement of a compressor is 850 cfm. The A.S.M.E. Nozzle Test determines that the true volumetric efficiency is 82 percent. The indicator diagram shows an apparent volumetric efficiency of 90 percent. Further assuming a pressure of 100 psi, gauge and standard barometer, the volume of actual free air at intake temperature and atmospheric pressure would be:

$$\frac{850 \times 82}{100} = 697 \text{ cfm};$$ the apparent volume of air read from the indicator diagram would be:

$$\frac{850 \times 90}{100} = 765 \text{ cfm}$$

$$\text{Slippage efficiency} = \frac{697}{765} = 91.1 \text{ percent};$$ the same result is obtained directly as the ratio of the determined or true volumetric efficiency to the indicated volumetric efficiency:

$$\text{Slippage efficiency} = \frac{82}{90} = 91.1 \text{ percent.}$$

**A.S.M.E. Power Test Code for Centrifugal Compressors*

*This completes Section 1; Section 2 on Air Distribution Systems will begin in the October issue.*

## Pioneers in Oil Hydraulics

Continued from page 103

James Hartness of Jones & Lamson Machine Co. took out several patents on hydraulic turret lathes, the earliest (739,866) in 1901. Hartness, long a leading figure at Jones & Lamson, subsequently became governor of Vermont. According to R. L. Tweedale of Vickers Inc., Conrad M. Conradson patented a vertical hydraulic lathe with automatic hydraulic feed (1,140,299) in 1914. Several of the lathes were built; one was used at Kenosha for several years to machine Nash fly wheels.

### *The Waterbury Development*

As far as is known, the first prototype of the present Waterbury pump is described in U.S. Patent No. 511,-044, issued to William Cooper and George P. Hampton, December 19, 1893. This was substantially the present Waterbury pump except that the cylinders opened against the valve plate at their full area without restricted porting. This resulted in a blow-off force which separated the cylinder barrel from the valve plate and caused failure.

This unit was intended for driving steam railway cars at a period when electric motors had not been sufficiently developed. Patents issued to H. D. Williams (893,558) in 1908 and to Reynold Janney (924,747) in 1909 both remedied this fundamental defect. Both showed the constricted cylinder ports reducing the blow-off area. The first axial plunger variable speed


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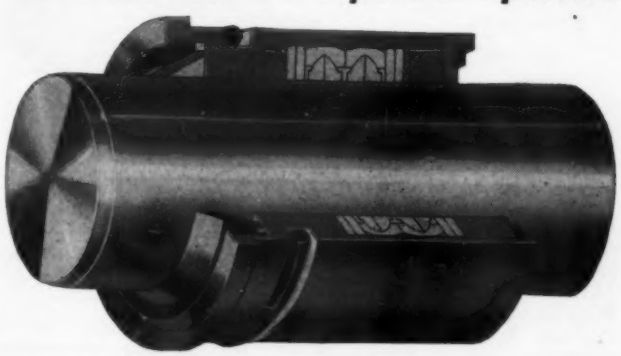

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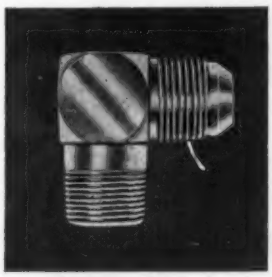

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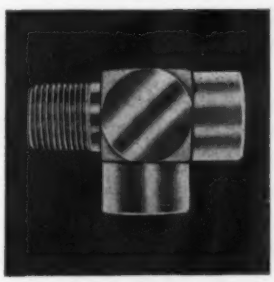

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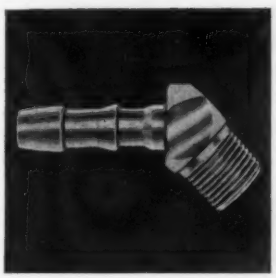

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hydraulic transmission was installed on the U.S.S. VIRGINIA in 1906.

The unit was taken up at this point by the Waterbury Tool Company and resulted, after development, in the present Waterbury transmission. The transmission has been used extensively in naval vessels for gun pointing and turret rotation, beginning around 1910. The same unit is built in England by Vickers Ltd.

### *The Lapointe Development*

The Lapointe Machine Tool Company, which this year celebrates its 50th anniversary, was a pioneer in the application of oil hydraulics to broaching machines. A variable delivery pump was first used by the Oilgear Company for operating a broach made by this company in 1922. The first Lapointe hydraulic broaching machine was delivered to the Buick Motor Company on July 26, 1923.

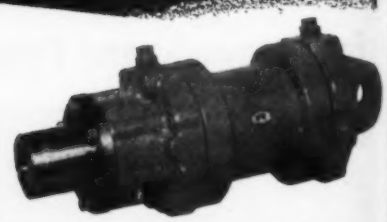
The original machine was a horizontal broach for internal work with an 8 inch cast iron cylinder mounted on the rear end of the machine bed. A variable delivery, multiplunger hydraulic pump provided for a maximum recommended pressure of 1000 psi. Draw rod stroke was 64 inches; speed was controllable from 0 to 24 fpm on the working stroke with a constant return speed of 60 fpm. A spring and plunger type stop automatically controlled the length of the work stroke.

A second somewhat smaller broaching machine, also pioneered by this company, had a cylinder of 5⅞ inches, a stroke of 56 inches and the same rates of

Continued on page 139


The Biggest PLUS VALUE in Cylinders

**For hydraulic pressures up to 1500 or 3000 p.s.i.**



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Use the hydraulic cylinder that will always give you plus performance in your equipment. Designed and constructed to J.I.C. standards, NEPTUNE-POWER PLUS cylinders are available in seven standard mountings—series 1500 for oil and water pressures to 1500 p.s.i.—series 3-1500 for pressures to 3000 p.s.i.

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# What's NEW in useful Free literature

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**Carbon Steel Tubing . . .** Technical information of value to engineers and designers associated with the fabrication of equipment operating at elevated temperatures and pressures, is presented in Technical Data Card 142, issued by the Tabular Products Division of Babcock & Wilcox. This carbon steel pressure tubing is used in the power, process and other industries, as conveying lines and as integral parts of various types of heat exchangers. This bulletin offers condensed data on mechanical and physical properties, upsetting, swaging, flanging, expanding, bending and welding of seamless and welded carbon steel tubing.

Circle 175 on Reader Service Card

**Supercharger Air Intercoolers . . .** Young Radiator Company has released a 4-page two-color Catalog No. 1652, which describes the two types of supercharging systems now in common use with 4-cycle engines—the low and high pressure systems. Air intercoolers are designed for cooling compressed air between the supercharger blower and the air manifold leading to cylinder of engines. Air cooling is performed in a tube and fin cooler, where the hot air passes over the finned surface, while the cooling water circulates through the tubes. The cooling fluid can be either fresh or sea water. Various types of intercoolers are illustrated.

Circle 176 on Reader Service Card

**Hydraulic Duplicators . . .** Turchan Follower Machine Tool Company has just published a new comprehensive catalog, in which it presents some of the basic advantages of converting standard machine tools to operation by hydraulic tracer control. The follower produces work at greater speeds, at accuracies no human operator could achieve. No machine is too small or too large to be equipped with the attachment. Any machine tool operator can readily handle intricate jobs. These are some of the features described at length in the catalog. There are 18 excellent illustrations of various machine tools which can be converted to fast automatic accurate production. Also shown is a circuit drawing of single dimension follower in typical application to a vertical mill. This literature should be a useful addition to production engineers interested in the output of their standard equipment.

Circle 177 on Reader Service Card

**Rod Packings . . .** The advantages of lattice-braid rod packings have been outlined in a new 8-page bulletin, issued by the Garlock Packing Company. Sectional drawings show the braided structure, which imparts to these packings a flexibility not obtainable in packings of standard braided construction. The structural design of this packing holds the integral strands together into a single unit even when the material is worn. Although lattice-braid packings properly cannot be classed as automatic packings, it is true that the controlled porosity of their construction imparts to the material a semi-automatic action. The bulletin contains illustrations, table of length and weights of packings in standard coil packages in sizes up to one inch, general service recommendations and specifications, as well as reports from users.

Circle 178 on Reader Service Card

**Grease Fitting . . .** An industrial catalog, describing grease fittings, has been published by Universal Lubricating Systems, Inc. Employing a design new to the field, the giant buttonhead is built to provide maximum grease flow. This new fitting with revolutionary one-piece construction is manufactured for use on all heavy industrial machinery. A complete line of these new fittings are offered in all regular sizes. Also described are other products manufactured by the company.

Circle 179 on Reader Service Card

**Precision Limit Switches . . .** The actuation of many solenoid operated hydraulic and pneumatic valves on aircraft is initiated by limit switch operation. Micro Switch Division of Minneapolis-Honeywell Regulator Company offers a reprint of 4-page article describing the application of precision limit switches on aircraft.

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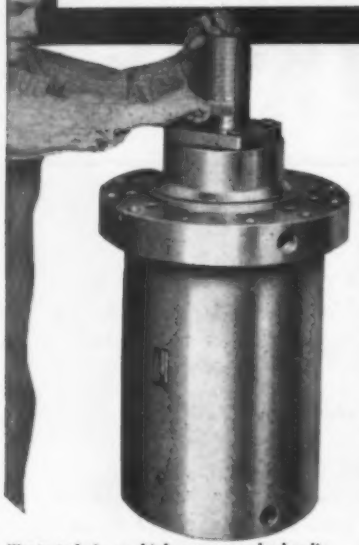
REMEMBER, HYDRO-LINE BUILDS 'EM



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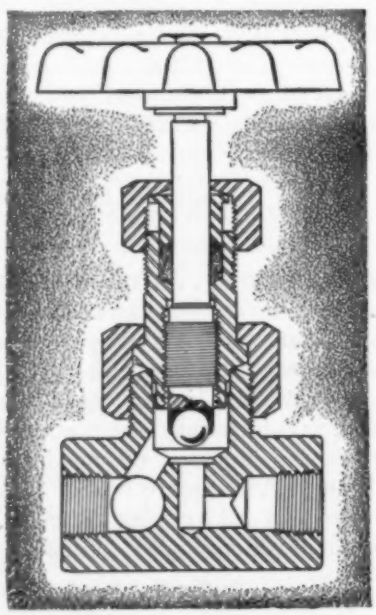

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In place of a disc or plug, the new Foxboro Ball Valve has a retained, free-rolling stainless steel ball that exposes new surface to seat at every closing.

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**High Pressure Pump** . . . Kobe Inc., Division of Dresser Equipment Co., released a 6-page illustrated bulletin on general industrial applications of the high pressure Triplex pump. This pump was originally developed to supply power for pumping oil wells hydraulically. Based on its successful employment in that field, the unit attracted attention in industries where requirements exist for self contained high pressure hydraulic power source. Shown and discussed in the bulletin are a number of standard applications calling for pressures up to 5000 psi. Also listed are special applications where pressures up to 20.000 psi are required. The bulletin contains installation data, operating description and tells how on-the-job variations can be effected by interchange of plungers and liners.

Circle 181 on Reader Service Card

**Pilot Check Valve** . . . An informative data sheet issued by Fluid Controls Inc. describes a new pilot check valve, designed and built for long trouble-free life. The data sheet outlines the use, operation and construction.

Circle 182 on Reader Service Card

**Back-up Ring** . . . A new type spiral back-up ring for "O" ring seals for hydraulic service, that will not shrink, swell, harden or soften, the KELON-T packing, is now in production at W. S. Shamban & Co. The back-up ring, made of Teflon, is chemically inert, has very low friction and is unaffected by oils, acids, bases or solvents. The useful temperature range is minus 110 F to plus 500 F. Standard sizes from .125 to 15.5 in ID and correspond in sizes of standard "O" rings.

Circle 183 on Reader Service Card

**Pressure Tester** . . . The Studebaker Total Pressure Tester, a self contained hydraulic unit for accurate, direct indicating of actual force in pounds of ram-on-work is described in a bulletin issued by Studebaker Machine Co. The unit, available in three popular sizes, can be used for determining weights and total forces in pounds on all types of presses, is described in Bulletin No. 62, issued by the company.

Circle 184 on Reader Service Card

**Seamless Mechanical Tubing** . . . A new bulletin "A Guide to the Use of Seamless Mechanical Tubing" (Bulletin TB-340) issued by The Tubular Products Division of The Babcock & Wilcox Company, is designed to assist the tubing user in determining whether he should use hot finished, cold drawn or "roto-rocked" seamless mechanical tubing. The bulletin outlines the differences in methods of production, surface finish, tolerances and costs of tubing finished by the three processes.

Circle 185 on Reader Service Card

**Molded Cup Packing** . . . A new bulletin on the Garlock Molded Cups for pump pistons, hydraulic service and pneumatic equipment is now available from the manufacturer, The Garlock Packing Co. The bulletin contains illustrations of various types of molded cups, service data and a complete list of sizes and part numbers. Typical applications are also shown.

Circle 186 on Reader Service Card

**Needle Valves** . . . A new series of Dimensional Data Sheets on their line of valves for fluid control have been increased for trade distribution by Hoke, Incorporated. Available in both aluminum bronze and stainless steel spindle models, in 1/8, 1/4 and 3/8 thread connections and maximum operating pressures of 2000 and 3000 psi, the needle valves are fully described.

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**Pressure Switches** . . . Catalog 1MB-1, issued by Meletron and Barksdale Valves, gives full engineering data on the line of Meletron pressure and vacuum actuated switches for industrial applications. The 32 page catalog also includes a glossary of terms, electrical rating of classes of switches, photographs and examples of pressure switch applications by industry.

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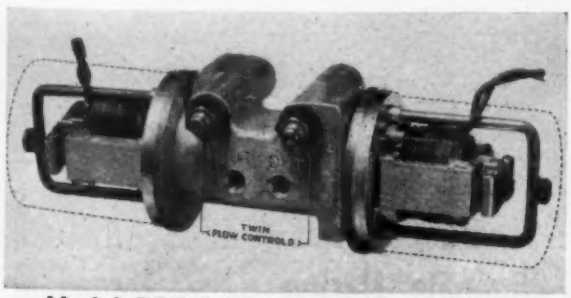

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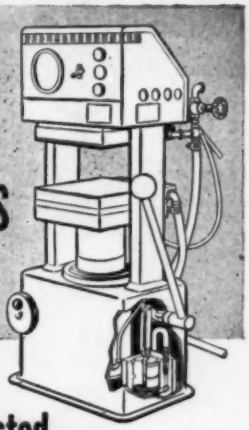

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## Why the Palmetto G-T Ring

**The Palmetto G-T Ring's ability to seal without extrusion is outstanding. Performance without extrusion has been obtained with pressures as high as *50,000 psi.***

***Its principle of operation is unusually simple:***

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Fig. 1 shows Palmetto G-T Rings with no pressure applied. CLEARANCES between the FLANGES of the RESILIENT SECTION and the laminated plastic NON-EXTRUSION RINGS, as well as between rings and CYLINDER WALL prevent low pressure friction.

Fig. 2 indicates how the RESILIENT SECTION flows under pressure, causing the FLANGE to swell under the rings on the low pressure side, bringing them to bear on the CYLINDER WALL. CLEARANCE spaces are closed, preventing any extrusion of the packing material. The piston, forced to a central position, will move forward without binding or jamming and with no damage to packing or CYLINDER WALL. Elimination of extrusion of the packing material is the outstanding feature that makes Palmetto G-T Ring Packing the ultimate in seals.

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3. REGULATED AIR PRESSURE — of discharge air is accurately controlled with no creep on gauge and minimum fluctuation from initial pressures.

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The Pneu-Trol Flow Control Valve combines an efficient Stainless Steel FLOATING BALL CHECK which opens and closes at the slightest change in flow direction, with a Vernier Type VARIABLE NEEDLE ORIFICE adjustment in a compact control which has widened air and hydraulic cylinder application by providing precise control of cylinder action. Modifications of the Pneu-Trol Valve are available as Plain Check, check with Fixed Orifice (orifice drilled by customer in the Standard Check Valve), Needle Valve and Velocity Limiting Check. All Pneu-Trol Valves are made from bar stock in brass (up to 1000 psi) or steel (5000 psi) or other body metals to your specifications. All internal parts are Stainless. All valves available in 5 sizes—1/8", 1/4", 3/8", 1/2", and 3/4".

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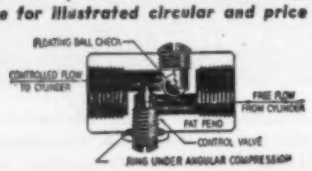


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**Mechanical Development Apparatus** . . . A new 16-page, two color, illustrated brochure MDA 200, published by Servomechanisms, Inc., describes the complete line of precision components for rapid and economical assembly of control systems instruments. In addition to the previously standard articles the brochure features a greatly expanded line of new mechanical development components, which include bevel gears, limit stop, bellows and oldham couplings, spring loaded split gears and others. Also shown are charts, diagrams and parts listing.

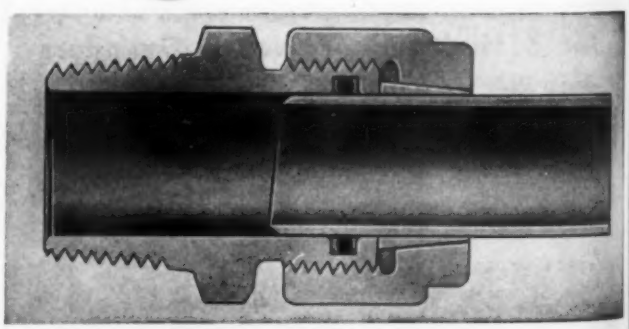
Circle 189 on Reader Service Card

**Swivel Joints** . . . High pressure hydraulic swivel joints are illustrated in Catalog 269, prepared by Barco Manufacturing Co., These joints are designed to meet the most critical aircraft and ordnance requirements and are available in a complete line of standard styles and sizes for industrial service. The joints are self aligning, absorb vibration, are compact and light in weight. Sectional drawings of styles and dimensions and thread sizes are also featured.

Circle 190 on Reader Service Card

**Air Equipment** . . . The Climax Rock Drill & Engineering Works, Ltd., in England, has issued a twelve page catalog on Maximum air equipment. Using compressed air power and standard air


**LENZ**
**"O-RING" TUBE COUPLINGS**



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- Seal and grip are separate
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Circle 87 on Reader Service Card

valves and cylinders, power operation can be applied to any mechanical process. Featured are air cylinders and air valves, with operational diagrams and illustrations. Also shown are some technical data and actual applications.

Circle 191 on Reader Service Card

**Hydraulic and Pneumatic Cylinders** . . . A new technical bulletin called "Cylinder Power in Action," which has been published by the Hanna Engineering Works, illustrates 16 cylinder powered movements and shows 21 actual application photographs. The bulletin describes how cylinder power can be utilized to speed production on all types of machines and equipment, and states that there are over 1001 ways throughout industry that hydraulic or pneumatic cylinders can be used to push, pull, lift, press, clamp and control. It further illustrates many hydraulic and pneumatic cylinders and manually and electrically operated control valves.

Circle 192 on Reader Service Card

**Industrial and Aircraft Valves** . . . A new catalog No. 352, now being distributed, gives complete specifications, drawings and construction features of the needle, globe, check, relief, plug and special valves made by Republic Manufacturing Co.

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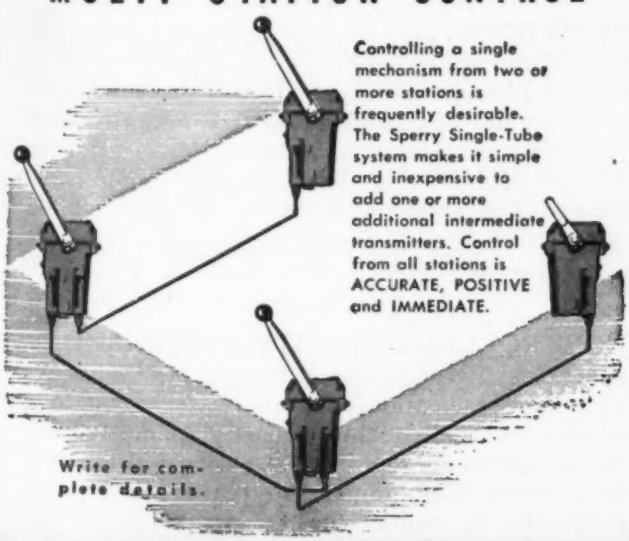

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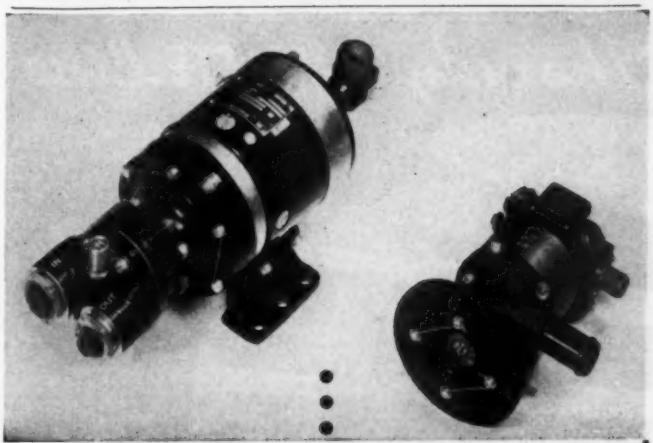

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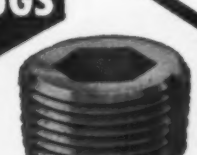

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**AIR CONTROL VALVES . . .** Airmatic Valve, Inc. has published a portfolio of bulletin sheets describing air valves for automatic control. A complete line of valves, with dimensional drawings, parts list and specifications are shown, as well as ratings and sizes. Included in this catalog are air and hydraulic cylinders, showing application, mounting and construction.

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**RESTRICTORS . . .** Engineering data on restrictors is offered by the GAR Precision Parts, Inc. These valves are unique in having a sharp edged orifice that has the same flow in both directions with a negligible variation. Two way and one direction hydraulic resistors are illustrated and detailed specifications given.

Circle 195 on Reader Service Card

**Packings . . .** James Walker Packing Company, Inc. has available an attractive 4-page catalog, featuring the Lion twin pak, which is composed of an endless U-ring with flat base and a specially designed male adapter ring. Special design features of the U-ring and the male adapter are detailed and very well illustrated in cross sectional drawings. This packing is most efficient for stuffing boxes where an endless type can be accommodated and where it is essential that friction should be reduced to the lowest possible figure. It has been designed for use on vertical reciprocating shafts or rams, and is made in materials suitable for wide pressure and temperature range, water, oil and practically every other hydraulic medium. Listed are also available sizes and a chart for recommended standard size and depth in relation to shaft and cylinder diameters.

Circle 196 on Reader Service Card

**RESISTORS . . .** A 64 page resistor catalog No. 15 has been published by the Ward Leonard Electric Co. Illustrated and described is the company's complete line of power-type wire wound resistors for every use. Valuable technical information is presented, including selection and application data with numerous charts and useful data tables.

Circle 197 on Reader Service Card

**CONTROLLED CAPACITY PUMPS . . .** Data sheet 65A offered by the Aldrich Pump Company, describes applications, features, design and operation of controllable capacity pumps. Also shown are sectional and dimensional drawings, ratings and diagrammatic layout of the type A automatic hydraulic stroke-control system for boiler feeding, oil burner supply and similar applications.

Circle 198 on Reader Service Card

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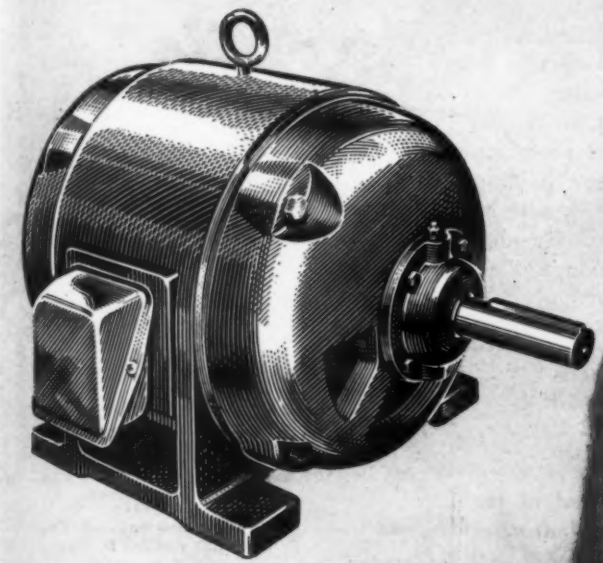

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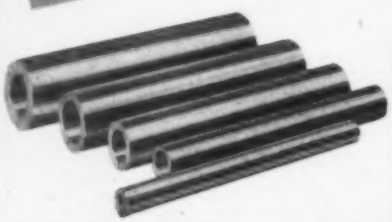

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## Design Features of a High Pressure, Single Stage, Rotary Vane Hydraulic Pump-Motor


*John R. English, Development Engineer, The Denison Engineering Co.*


Vane type pumps or fluid motors are inherently capable of large displacement from a relatively small unit; therefore, they are capable of developing a large amount of power provided the design features permit operation at fairly high pressure.

Rotary vane units vary considerably in their basic operating principle which at first inspection is not too apparent. Most vane pumps commercially available will operate to 1000 psi, a few will operate up to 2000 psi. Very few will operate as fluid motors at any pressure.

A new vane type unit which Mr. English describes in this paper incorporates a unique vane loading and porting principle which permits the unit to be used interchangeably as a pump or fluid motor without alteration of internal parts.

## Abstracts of Papers Presented at the NCIH September 1952

*Here are abstracts of several of the papers being presented at the National Conference on Industrial Hydraulics, September 4 and 5. All papers will be published in the Conference Proceedings which will be available early in* 1953.

These various theories are illustrated and discussed: Advantages and disadvantages of balanced and unbalanced type vane units. Hydraulically loading vanes and their relationship to the pumping cycle. Static and dynamic loads acting on the vane during the pumping cycle. Effect of fluid motor operation (reversible rotation) on vane shape and position. Recommendations for vane material to withstand high temperature.

A method for providing uniform acceleration and deceleration to the vanes by a mathematically determined cam profile is described. Alteration of the cam profile to provide precompression and decompression of the fluid being transported between ports is discussed as well as the effect of bleed slots


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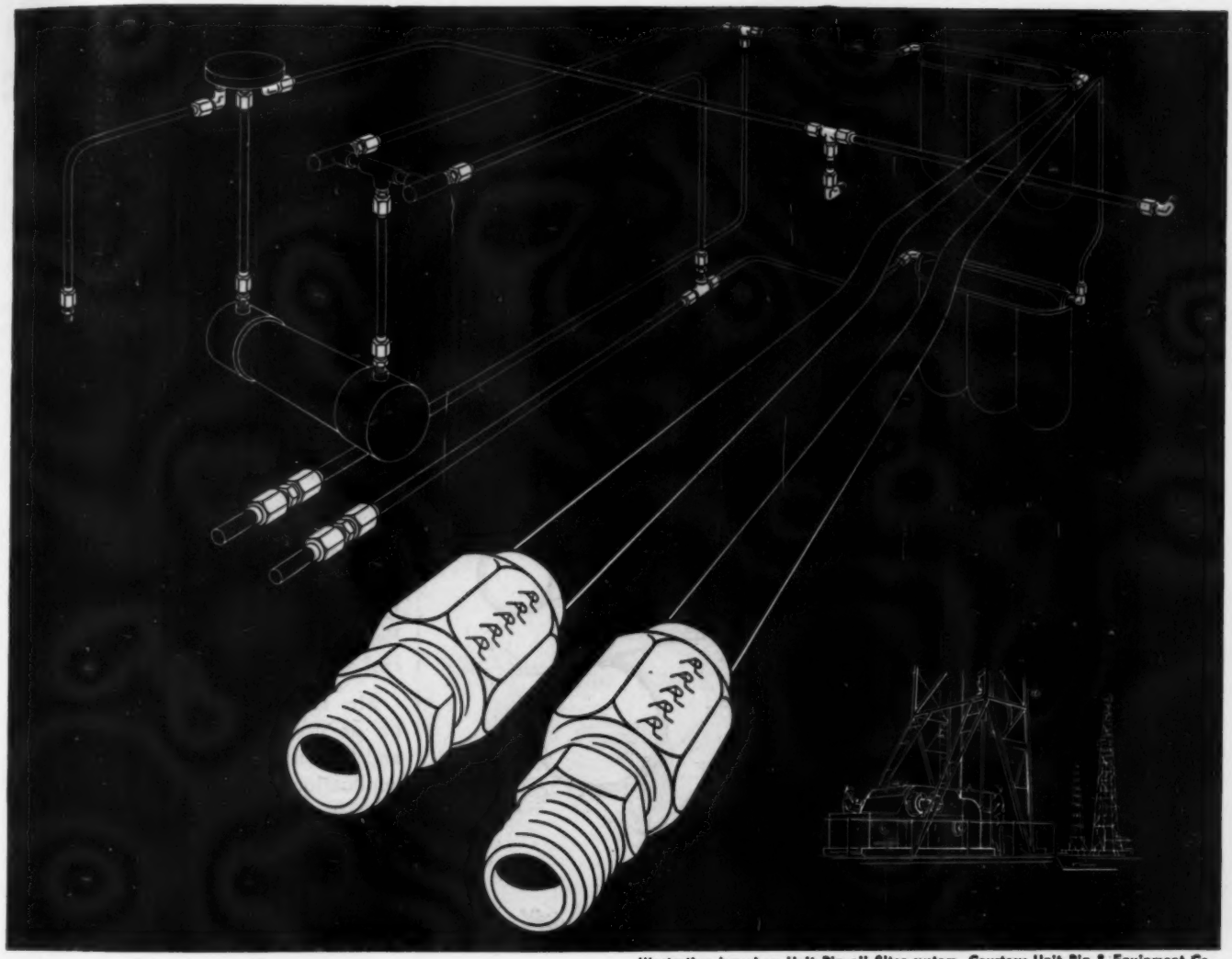

Illustration based on Unit Rig oil filter system. Courtesy Unit Rig & Equipment Co.

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or orifices as means of reducing pulsations and noise.

Sectional drawings and illustrative sketches of the new pump-motor design are shown and the operation of the unit as both pump and motor are described. Performance curves for operation as a pump, motor or transmission are presented, curves and data are based on laboratory tests. Effect of oil temperature and viscosity on pump performance is presented in graphic form.

Units have been successfully tested as both pumps and fluid motors in capacities of 2 to 70 gpm at pressures in excess of 2000 psi.

### Hydraulic Equipment Design, Construction, Operation, Maintenance

*J. R. Hemeon, Hydraulic Equipment Engineer, Ternstedt Division, General Motors Corporation.*

Mr. Hemeon's paper, which will be of great interest to operating and production men, shows how the application of sound design and construction methods save dollars in maintenance and operation.

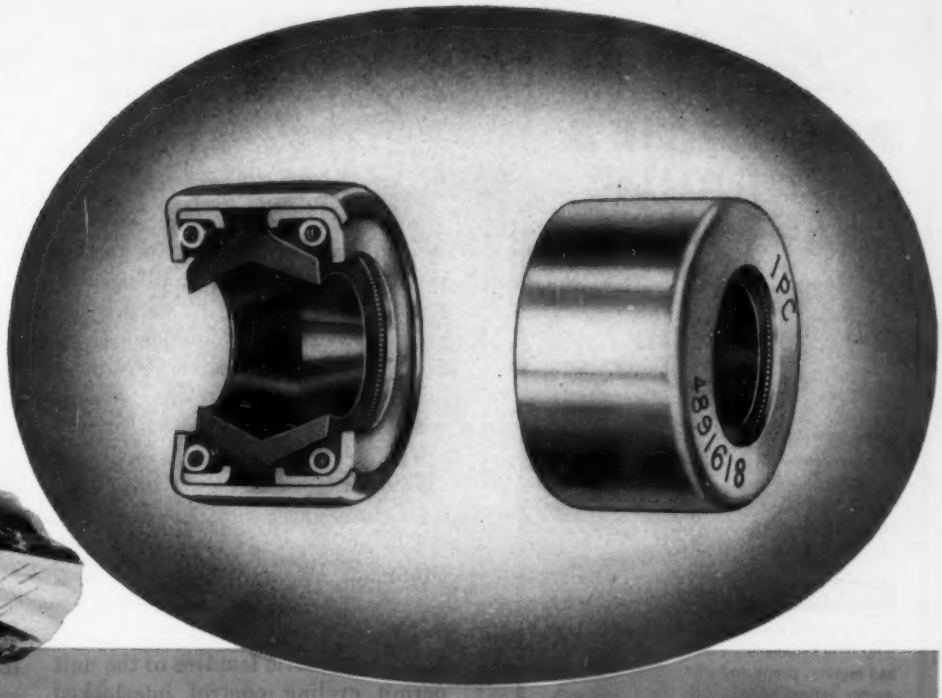
He discusses methods of computing amount of heat generated in a hydraulic system and means of dissipating this heat. The paper describes efficient tubing and component arrangement.

In discussing oil characteristics, Mr. Hemeon points out that by careful selection of oil and proper circuit design his company has kept the same oil in operation for over 12,000 hours.

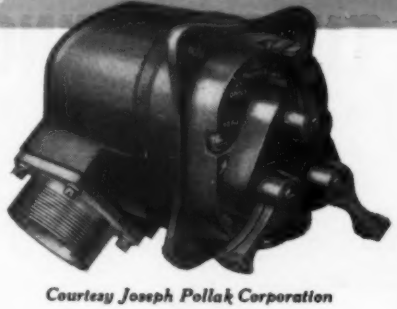
Using photographs, drawing, and tabulated data, this paper shows how THINK-HYDRAULICS have paid dividends. The use of slides shows how scale layout drawings have reduced manufacturing cost, improved hydraulic efficiency, incorporated low maintenance cost, and provided safety. A section on the "Hydraulics Instruction Course" which trains hydraulic mechanics and keeps them up to date will be appreciated by shop maintenance groups.

This paper has been prepared to show the integration of the four sub-subject heading: construction, design, operation, and maintenance. The paper describes how the down time in the die cast department has been reduced from 14 percent to less than 1 percent.

**the water has no place to go—*but out!***




# These 3 seals designed and made by G&K-International keep the water out of this electrical throw switch



*Courtesy Joseph Pollak Corporation*

The AR5 Ordnance Lighting Switch pictured here will make and break the circuits *under water*. Three separate throw type contact switch mechanisms are operated by three levers located on the outside of the case. Surrounding each lever shaft is a seal, specially designed to keep water from passing along the shaft.

As shown in the cut-away view, the sealing elements are synthetic rubber, precision-molded with two balanced lips, each tension tightened by garter springs to insure a uniformly secure grip — and housed in a steel casing. More than 70,000 of these seals have been furnished to this one manufacturer.

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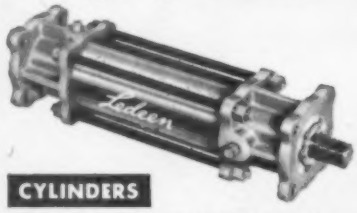

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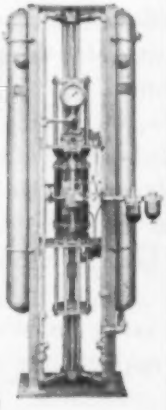

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**Air Powered Hydraulics**

*Clarence Johnson, Consultant Engineer, and Paul E. Butzin, Director of Research and Engineering, Delta Power Tool Division, Rockwell Manufacturing Co.*

Mr. Butzin's paper discusses the use of the air hydraulic principle on automatic drill head applications. The manner in which air power, hydraulic feed, mechanical functions, and electrical control are combined to furnish a compact self contained unit are shown.

The method of combining the various control means to obtain the most universal and versatile unit result in a unit which is readily adaptable for building up special purpose drilling machines with the least effort.

The automatic features of the unit permit cycling control interlocked with other units or with indexing and clamping mechanisms and makes available a unit which the user himself can use as a component part of a special purpose machine.

Mr. Butzin describes the early steps in the development of the Delta air hydraulic drill head. Solutions to problems involving pressure switch actuation, maintenance, cylinder bore finish, packing selection and quill design are presented.

Mr. Johnson discusses some of the theory of air hydraulic systems and describes the two types of systems in common usage.

The most common system utilizes one cylinder for the compressed air to furnish the power and a second one for oil to provide a dashpot like control element. The two cylinders are tied together mechanically, sometimes with an adjustable backlash to furnish rapid approach.

The second system may use two or more cylinders, but in each cylinder one side of the piston contains air for driving force and the other side oil for control. The main cylinder is the power cylinder of the system and the others act only as receivers or reservoirs. In some cases the secondary cylinders may be replaced by a reservoir with oil coming up from the bottom and air on top. The position of the cylinders relative to each other is immaterial since they are connected hydrau-

Continued on page 135

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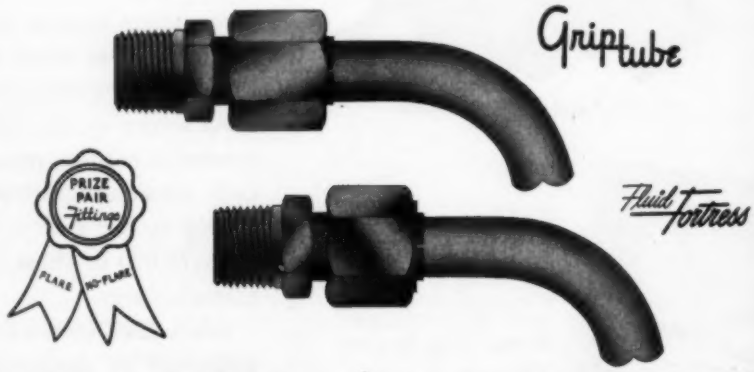


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Circle 52 on Reader Service Card

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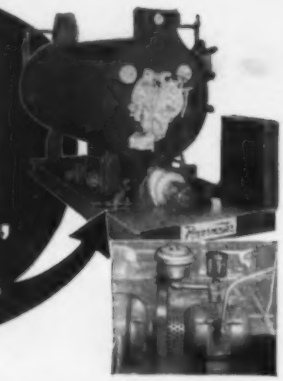

See our CATALOG in SWEET'S FILE

Gast Application Ideas Booklet — showing 26 design problems solved — sent upon request.

**PROBLEM:** Select a compressor to supply uniform, pulseless air volume for atomizing fuel oil in the combustion chamber of Orr & Sembower "Powermaster" Boilers.

**SOLUTION:** Three sizes of Gast Rotary Air Compressors proved excellent for boilers of 50, 100 and 150 H.P. Gast Rotary Vane Design delivers positive, pulseless pressure from 18 to 22 psi and displacements to 22 cfm — *without* a bulky pressure tank.

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Circle 21 on Reader Service Card

Continued from page 132

lically rather than mechanically. This makes it possible to insert control means in the connecting piping and achieve a control that functions in a manner very similar to a conventional hydraulic system. This system also makes it possible to make the receiving cylinders large so as to take care of normal leakage and volume changes.

The Delta drill unit is typical of a design built around the second system. The unit incorporates three basic moving elements: main piston integral with the quill, and the feed and rapid advance sealing piston. The length of the stroke of the quill is controlled within .0005 in. by means of a positive stop nut. The length of the rapid approach stroke is also controlled by means of a positive stop. The rate of feed is infinitely variable from 0 to 50 inches per minute. Using illustrations, Mr. Johnson details the cycle of operation of the drill head.

Some of the problems that had to be solved and are discussed include: oil leakage, surface finish, designs to prevent scratching of high finishes, "O" ring life, prevention of mixing oil and air, controls and cost of operation.

### Tube and Tube Fittings

*Lee H. Schmohl, Staff Engineer, The Parker Appliance Co.*

This paper is concerned with tubes and tube fittings used in aircraft and industrial applications as differentiated from the common piping of ordinary plumbing installations.

It reviews the development of tubing and tube fittings which came about because pipe and pipe fittings were not suitable for certain requirements.

It describes the tube fittings standardization that has taken place in the automotive industry, the progress of tube fittings standardization in the aircraft industry, and the development of tube fitting standards in general industry. This description encompasses the work done by various standardization groups to promote coordination between user and manufacturer to accomplish interchangeability, the need for which becomes even more apparent under national emergency conditions.


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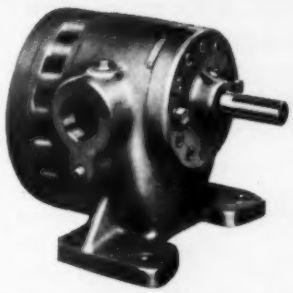

Roper *dependable* Pumps! Smooth running units that add to the efficiency of diversified hydraulic applications. The Roper principle of only two moving parts—equal size pumping gears operating in a sturdy case with proper clearance—results in superior serviceability and promotes long life. The Roper Pumps illustrated are representative of standard pumps suitable for most installations. For unusual applications, let Roper engineers work with your design engineers in developing a special Roper to fit your needs.

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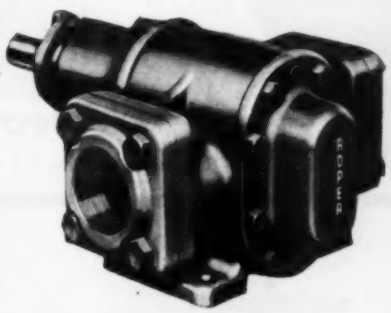
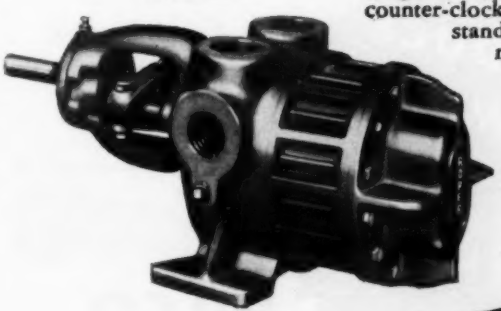


**SERIES K** . . . Pressures to 150 P.S.I.—Capacities ¾ to 50 G.P.M. Compact, yet sturdy enough to handle a wide range of jobs. Self-lubricated by liquid being pumped . . . handle total suction lifts up to 25 feet . . . come equipped with mechanical seal or packed box, with or without relief valve. Easy to install and apply.

SEE OUR CATALOG IN SWEET'S



**SERIES F**... Pressures to 300 P.S.I.—Capacities 1 to 300 G.P.M. Popular pumps that feature 4-port design (eight optional piping arrangements, 4 for clockwise and 4 for counter-clockwise rotation.) Supplied in standard or stainless steel fitted models to suit specific needs. Furnished with or without relief valve, with mechanical seal or packed box. Ideal for hydraulic power generation in a wide range of applications.

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In covering this subject, the paper discusses the different kinds of tubing and standard tube fittings commonly used in automotive, aircraft and general industrial fields, explaining the various construction and features of the different types of fittings and the means of attaching them to tubing.

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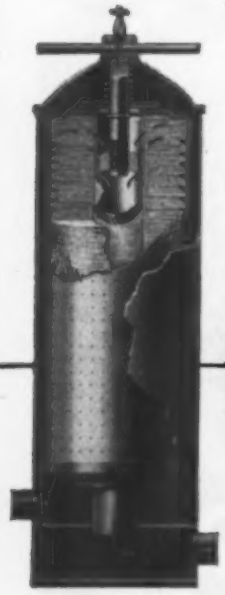
## NEW PUBLICATIONS

### Practical Design Guide

A new source book of practical ideas by Richard Rinehuls, an experienced, successful designer, should serve as a stimulus for ideas as well as a guide and reference for those who are developing machines, tools and manufacturing methods. Pneumatics is covered comprehensively—valves and cylinders are discussed and practical circuits and applications given. Other sections are devoted to automatic feeds, springs, Geneva movements and practical applications and the development and



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design of cams. "Practical Design Guide" is published by the author, P.O. Box 549, Binghampton, New York at $2.00.

### Equivalent Valves

A revised, enlarged edition of this time-saving, loose leaf manual, long a standby for designers and buyers of valves, is now ready. Prepared by Gordon Hawes (M.I.T. 1910), the new edition lists sizes of cast iron and bronze valves for the first time. The valves of 18 different manufacturers are indexed under every structural variation, design feature, pressure rating and material. A total of 50,000 individual postings and cross indexing makes it easy to find, compare and select valves in a fraction of the time that would be required to search through individual manufacturers' catalogs. The manual, constructed of rugged red and black leatherette cover with heavy spring closing rings, is priced at $25.00 per copy with annual revision service also available. Copies may be obtained from Equivalent Valves Co., fifth floor, 115 West 7th St., Los Angeles 14, Calif.

### Supersonic Aerodynamics

The new handbook of Supersonic Aerodynamics, Volume 4, a Bureau of Ordnance publication, is now available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. at $1.25 per copy.

### Maintenance Problems

A comprehensive discussion of plant maintenance problems is contained in "Techniques of Plant Maintenance—1952," published in June by Clapp and Poliak, Inc., New York, which conducts the annual Plant Maintenance Conference and Show.

The book, which contains the proceedings of the conference, is highlighted by the text of 717 questions set forth by 2,100 engineers from every major industry in the country who attended the sessions. The book represents the best cross-section of current industrial engineering thought on maintenance problems.

Texts of all papers read at panels led by 36 leaders in the field are included, and the papers are illus-

Continued on page 151


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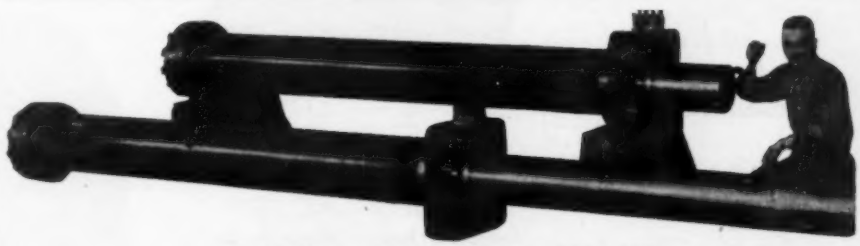

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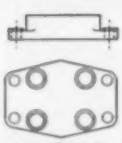
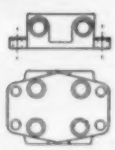
Cam Controlled



Bottom Port Base



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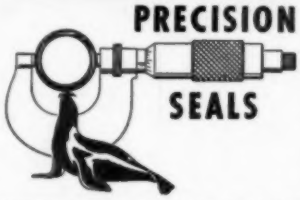

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# Pioneers in Oil Hydraulics

Continued from page 120

cutting and return speeds and the same control of stroke length.

Some of the earliest users of these machines included Dura Manufacturing Company, Toledo, Ohio, July, 1924; C. B. Cottrell, Westerly, R.L., March, 1925, Spicer Manufacturing Co., Pottstown, Pa., April, 1925; Cadillac Motors, Detroit, Mich., May 1925; and International Harvester, Chicago, Ill., April 1926.

### *The Oilgear Development*

The Oilgear development was inspired by a need for a variable stroke unit for driving the deeper thrusting methods on excavating machines when the machine itself came to be driven by an internal combustion engine. During 1909, W. E. Magie, a draftsman for the Bucyrus Company, was interested in developing a hydraulic transmission for automobile drives. About this time, Walter Ferris, then engineer in charge of designing Bucyrus machinery, became interested. Faced with the problem of changing excavators over from steam power to internal combustion power, the crux was a form of flexible drive to transmit power to the working elements of such machines.

Small experimental units were built. First tested as drives for machine tools in the Bucyrus shops, subsequent units were built for a small shovel. First tested in 1916, the units gave some promise and development continued. In the next four years progress was made under the encouragement of E. K. Swigert, vice president of the Bucyrus Company.

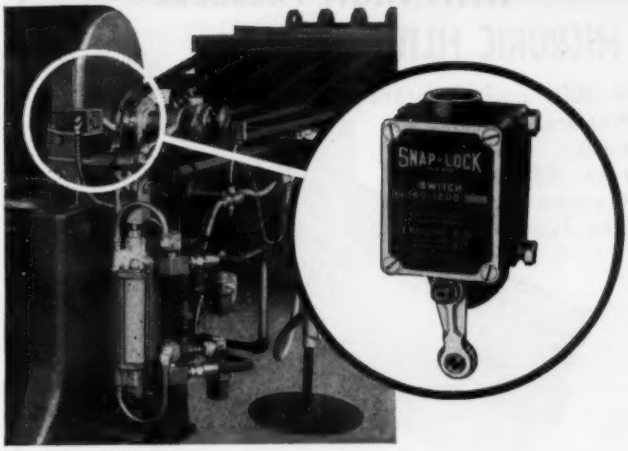
Early in 1921 The Oilgear Company was organized by E. K. Swigert and Walter Ferris to manufacture and market hydraulic transmissions and machinery based on earlier development work. The Bucyrus Company held exclusive rights to Oilgear developments in the fields in which the former was active, the new Oilgear Company had rights to all other fields.

The Oilgear Company, under the stimulus of a strong demand for a better means of feeding the cutting tools to the work in various machine tools in automobile plants, developed a number of small variable displacement pumps and motors for the feeding of machine carriages. Such pumps were adapted to operate carriages or rams of machine tools, providing a combination of easily adjustable feed rates with an instantly available traverse in either direction.

About this time The Oilgear Company placed on the market the first hydraulic broaching machine, using a variable displacement pump and a hydraulic cylinder to pull a broaching too through the work piece. The result was a radical improvement in efficiency, cutting speed and production as compared with the then conventional mechanical screw type broaching machine. Early in 1924 the Oilgear Company pioneered the development of the first self-contained high speed hydraulic press.

In 1925 the first satisfactory automatic "feed controller" was introduced. First used on a large multiple spindle drill at the A. O. Smith plant, the unit quickly was adapted to many machine tools.


SNAP-LOCK TRADE MARK – For Split-Second Precision

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The Coe Manufacturing Company, "world's largest makers of veneer machinery," have devised their own special type of torture test for limit switches in their new air-operated veneer clipping machine. No ordinary switch could survive the ordeal of operating 400 times a minutes under such heavy duty service.

Snap-Lock passed the test with flying colors! Its record of dependability is renowned; over 80% of the nation's machine tool builders have standardized on Snap-Lock for dependable service.

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1. Separate sealed electrical and mechanical sides (for added safety)
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4. SNAP make and break (fast acting — accurate)
5. Coin silver self-wiping contacts (no arcing)

Snap-Lock Limit Switches are built in a variety of types and sizes, to suit every industrial application; special mountings are available. May we show you how they can be designed into your product?

The complete range of Namco standard Snap-Lock Limit Switches is illustrated and tabulated in our new engineering bulletin EM-51. Be sure to get your copy.

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In 1933 The Oilgear Company introduced the rolling piston pump. As the business expanded abroad, arrangements were made with Weatherley Oilgear Ltd. of London for the manufacture of machines to Oilgear designs and the distribution of primary hydraulic equipment in Great Britain.

### *Military Applications*

New lines of variable and constant displacement pumps and motors were added and at the outbreak of the Second World War, the company was in a position to accept contracts for heavy military requirements. In addition to applications on single purpose machines, units for elevating and traversing tank turrets and antiaircraft guns were built in very large numbers.

Recently large committments have been made by the company for similar units on various types of combat vehicles.

### *"The Story of an Apple"*

The Hydraulic Press Manufacturing Company this year celebrates its 75th anniversary. The first press, designed by the founder Augustus Q. Tucker to make cider, was built in 1877. For many years water hydraulic presses were built.

In 1926, a high speed oil hydraulic press, equipped with the HPM radial piston pump, was offered to industry. From the first the presses were completely integrated, the company building press frame, radial pumps, valves and controls.

During the Second World War and at the present time, the capacity of the plant was, and is, largely devoted to large drawing and forming presses for the aviation industry—cartridge case presses, shell forging presses and gun barrel straightening presses. Normally a wide range of metal working presses are built—extrusion, deep drawing, forging, embossing, die casting, powder metallurgy, and die straightening among others. In the process field, presses for ceramics, salt, carbon, rayon, wood and plastics are offered.

### *The Lassman Development*

Benjamin Lassman of Benjamin Lassman and Son, is one of the pioneer builders and engineers in the oil hydraulic field with more than 30 years of service. Lassman is one of the relatively few "old timers" still active.

As he recalls, the three first manufacturers of oil hydraulic equipment were American Engineering Co., the Waterbury Tool Co., now a division of Vickers, Inc., and The Oilgear Company. Oilgear concentrated on machine tool applications; Waterbury's emphasis was on marine and on machine tools. American Engineering is one of the leaders in the field of marine electrohydraulic steering gears. While first limiting their attention to this field, this company early emphasized heavy duty mill applications, especially in the Pittsburgh area, where Lassman, who represented them, was active.

The early hydraulic applications had to be designed, constructed, installed and maintained by the scant staffs

# DEECO

## A NEW NAME IN INDUSTRIAL FITTINGS FOR HYDRAULIC EQUIPMENT

The Deutsch Company which has had many years of experience in producing precision parts for both the aviation and industrial fields, introduces a new line of industrial hydraulic tube fittings designed especially for application in hydraulic circuits, instrumentation and power systems.

For complete details write for Catalog No. 52.

**Desirable territories open to qualified hydraulic equipment distributors.**

Warehouse Stock: Neilsen Hydraulic Equipment, Inc.
298 Lafayette Street
New York 12, N. Y.

The Deutsch Company method of packing protects threads and simplifies inventory control.

## THE DEUTSCH COMPANY

7000 AVALON BOULEVARD • LOS ANGELES 3, CALIFORNIA

of the first manufacturers. Sales went to the intrepid and persevering engineer.

The opportunity for hydraulic equipment in steel mills was through the continuous duty requirement. Equipment had to be rugged and at the same time as simple and as foolproof as possible. It was necessary for Lassman, as well as all others, to make their own cylinders and valves. Lassman, for example, built the largest high pressure valves used at the time—6 inch prefill valves for 3000 psi service. He built and named the first "sequence" and "open center" hydraulic valves. He was the first to habitually use heavy pipe, socket weld fittings and forged steel in sizes one inch and larger.

### *Pioneer Mill Applications*

Among the earliest steel mill applications made by Lassman, all more than 20 years ago, were: pipe crushers, extruders, sheet stretchers (ferrous and non-ferrous), annealing box straightener, hydrostatic pipe testers, plastic forming, tilting tables, equipment for electric porcelains, ceramics and refractories, billet brakers, transfer conveyors, slab shears and "hot saws" or cutoffs for hot billets.

In 1930 Lassman pioneered the building of the first fully automatic electro-hydraulic machine for the ceramic industry, a 450 ton press for making refractory brick. He also pioneered in high speed metal forming press design, his design for a semi-automatic hydraulic press stepping up the closing speed from 20 inches per second to four feet per second.


Circle 114 on Reader Service Card

**You can use this hydraulic quick coupler at oil pressures up to 30,000 psi**

No. 3000
Pioneer Hi-Pressure
Quick Coupler

- This 3/8" Coupler will handle up to six times more fluid than other couplings of equal size with almost no turbulence.
- Perfectly centered steel ball checks give maximum free area, resulting in extremely low pressure drop.
- Guaranteed at 30,000 p.s.i. burst pressure when coupled; each half at 15,000 p.s.i. uncoupled.
- Will recouple and swivel at low pressures with no loss of oil.
- Using a new "O" Ring groove designed for long life, easy recoupling, and perfect seal.

**PIONEER PUMP MFG. CO.**
121 NO. 1st ST. MINNEAPOLIS, MINN.

**O-RINGS by INJECTION MOLDING**

***Dependable Hydraulic Seals***

Minnesota O-Rings function in air or gas systems as well as in hydraulic systems. Air cylinders . . . hydraulic valves . . . hoisting mechanisms . . . water pumps . . . bottling machines . . . refrigerators . . . motors . . . lubricators . . . are a few of their uses. Minnesota's exclusive injection process makes possible very close dimensions, uniformity in mass production and downright economy. We use special compounds of synthetic rubber to meet your exact requirements. Let us quote on your next hydraulic packing installation.

*Manufacturers of all types of small rubber parts*

**Write for O-Ring Catalog**

**MINNESOTA RUBBER & GASKET CO.**
3630 WOODDALE AVE., MINNEAPOLIS 16, MINN.

**Sterlco**
**Series 150E**
**TEMPERATURE CONTROL**

Keep oil temperature constant with this compact, self-contained, completely automatic, low-cost unit installed in your heat exchange system. Eliminate the human element at the cooling valve. Remember, oil too hot means slippage . . . too cold means sluggish operation and wasted cooling water.

*Send for complete details.*

**MOUNTS AND OPERATES IN ANY POSITION**

MANUFACTURERS OF TEMPERATURE CONTROL EQUIPMENT SINCE 1918

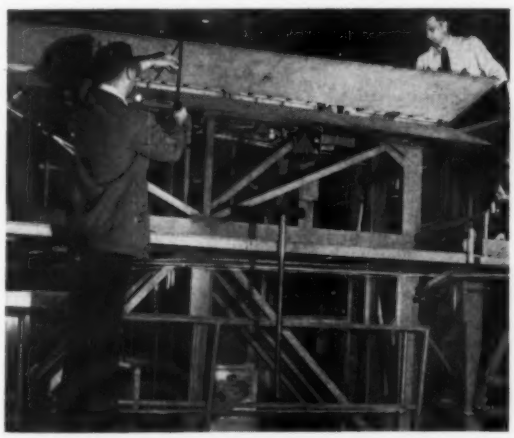
INDUSTRIAL CONTROL DIVISION
**STERLING, INC.**
3742 N. Hatton Street • Milwaukee 12, Wis.

# Windless Wind Tunnel

RESEARCH engineers at Northrop Aircraft Inc., Hawthorne, Calif., have developed a "windless wind tunnel" that uses electronics instead of the usual artificial hurricane to simulate flight tests of the USAF's Northrop Scorpion F-89 all-weather interceptor. Without ever leaving the ground, test engineers use an electronic analog computer to project a life-sized hydraulic mock-up of the F-89 through all the maneuvers of a high-speed, high-altitude test flight.

Through the use of this new device, information on flight performance can be obtained at a fraction of the cost of actual flight tests. Many man hours of labor and months of valuable research time are saved.

The new electronic wind tunnel was developed by harnessing "Iron Ike"—an authentic mock-up of the full-power control systems used in the F-89s, to an electronic computer designed and built by Leonard Nalley, Northrop servomechanisms engineer.



**TEST ENGINEERS,** Warren Schreyer, left, and Lee Beydler, check the operation of F-89 dive brakes on the mock-up of the power control systems at the Northrop plant at Hawthorne, Calif. The "windless wind tunnel" eliminates many hours of actual flight testing.

The wind tunnel is constructed on a giant test stand built of structural steel network and contains all of the mechanical, hydraulic and electrical control devices used on the F-89. Varying external conditions of air flow, temperature and altitude are introduced into the windless wind tunnel by changing settings on the computer. The electronic tunnel then absorbs a few mathematical formulas in its computer element and almost instantly provides data on the performance of the airplane.

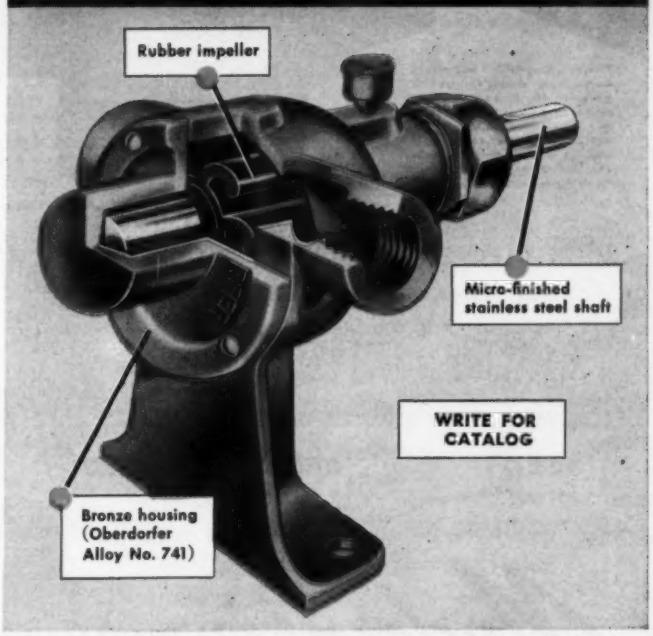
The computer simulates aerodynamic characteristics of the airplane through solution of differential equations involved in dynamic stability, kinematic performance and similar theoretical aerodynamic studies.

The versatile flight simulation device provides a means for the rapid evaluation of the component parts of a power control system by substituting new units into the system; it can test an autopilot under exacting conditions; it serves as a workshop for the development and evaluation of the complete control


Corrosion Resistant **Series IV**

**OBERDORFER INTERNATIONAL**

**Rubber Impeller BRONZE Pumps**




**For low pressure transfer of pure or contaminated liquids not affecting our Neoprene impeller.**

The Oberdorfer design has stressed port openings for maximum flow capacity while maintaining a wide area of wall support for the impeller. This results in a highly efficient mechanism with a long service life when handling many contaminated liquids.

These pumps are self-priming to about 20 feet when the impeller blades are wet. Where possible a check valve should be installed on the suction side of the pump to insure constant pressure of the liquid being pumped about the impeller. Drive may be either clockwise or counter-clockwise. Maximum pressures range between 20-30 p.s.i. The rubber impeller is keyed to the shaft and may be replaced in a matter of minutes.

**CAPACITY TABLES** — Gallons of water per minute — 1,725 R.P.M. Outlet pressure in feet head and p.s.i.

| Pump No. | Size | Ft.hd. p.s.i. | 0 0 | 10 4.3 | 20 8.7 | 30 13.0 | 40 17.3 | 50 21.6 | 60 26 | 70 30 |
|---|---|---|---|---|---|---|---|---|---|---|
| RA | ½" | | 6½ | 6 | 5¼ | 4¼ | 3½ | 2½ | 1 | — |
| RB | ¾" | | 10¾ | 10 | 9 | 8 | 7 | 5½ | 4¾ | 2¼ |
| RC | 1" | | 21½ | 20 | 18½ | 17 | 15½ | 13½ | 11¾ | 8½ |

**DIMENSIONS**

| Pump No. | Length | Width | Height | Price |
|---|---|---|---|---|
| RA | 5⅜" | 4¼" | 4⅞" | $16.00 |
| RB | 6⅜" | 4¼" | 4⅞" | 21.00 |
| RC | 7⅜" | 4⅞" | 5 13/16" | 28.00 |

**INDUSTRIAL PUMP DIVISION**
**Oberdorfer Foundries, Inc.**
**529 Thompson Rd., Syracuse, N. Y.**

See our catalog in Sweet's File for PRODUCT DESIGNERS

Circle 99 on Reader Service Card

Stock Delivery for

MODERNAIR CV SERIES

"the Versatile Valve"

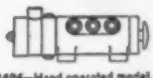
FOR AIR, WATER & LOW PRESSURE HYDRAULIC SERVICE

Twenty different left end attachments are available for use with each of 14 Modernair basic valve models — nine of which are illustrated below. In all, nearly 280 distinct valve combinations may be produced using the basic body casting in either ⅜ or ½-in. pipe size.

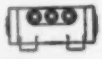
0606—Electric operated model, solenoid controlled secondary valve attachment. Solenoid electric controlled return.

1401—Foot operated model, treadle attachment; manual setting.

1502—Cam operated model, cam stem attachment; internal compression spring return.



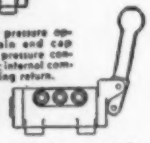
1606—Hand operated model, palm attachment; single coil electric controlled return.



0502—Pilot pressure operated, plain end cap tapped for pressure connection only; internal compression spring return.

1302—Foot operated model, pedal attachment; internal compression spring return.

0808—Cam operated model, roller cam attachment; roller cam return.



1001—Hand operated model, lever attachment; manual setting.

Modernair TRADEMARK CORPORATION

400 PREDA ST. SAN LEANDRO, CALIFORNIA

systems of an airplane under both normal and extreme temperature conditions; and various aircraft designs can be studied to determine the best one for obtaining maximum response and satisfactory stability for a proposed airplane.

**THE ACTUAL** operating mechanism of the dive brakes is utilized in simulated flight tests for the Scorpion F-89. Warren Schreyer notes operation of the brake assembly.

Warren C. Schreyer and Lee W. G. Beydler of the Northrop engineering test laboratory are credited with much of the pioneering and research work on the flight simulation device.

Final response data on the airplane in flight cannot be obtained with the wind tunnel, but by eliminating much of the preliminary investigation, actual flight tests can be held to a minimum.

HYDRAULIC POWER UNIT

For Payoff Reel Cylinder

The hydraulic power unit illustrated is furnished with solenoid controlled relief valve and pressure switch operated in conjunction with Hydro-Pneumatic Accumulator. This combination maintains pressure to keep coil drum expanded during payoff cycle and unload pump whenever only holding pressure is required.

"HYPECO"

HYDRAULIC POWER EQUIPMENT CO.

Custom & Standard Hydraulic Power Units

Box 431 North Lima, Ohio (Youngstown Suburb) Phone 9-3717

LARGE PROCESSOR CHOOSES

Nicholson Valves for LONG WEAR

Nicholson cylinder control valves recently completed 10 years of constant use, without servicing, on an operation which had proved too much for other tested units. This report, from a large rubber firm, again confirms the fact that Nicholson valves, with their specially treated hard seats and non-corrosive lapping flat discs, become tighter with use. Nicholson furnishes valves for cylinder control, distributing and metering service, and for many special operating cycles. For air, gas, oil, steam, water.

Foot models (right), ¼" to 1½"; press. to 300 lbs.

Solenoid (left) and motor types, ⅛" to 2½"; press. to 375 lbs. Lever models (right), ¼" to 2½"; press. to 5000 lbs.

CATALOG 552

213 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS



Circle 73 on Reader Service Card

Circle 105 on Reader Service Card

# AIR CIRCUIT DESIGN SIMPLIFIED WITH THIS SOLENOID CONTROLLED AIR POWERED AIR VALVE

**COMPLETE:** Combines in one unit 4-way directional slide valve, piston rod speed regulators and low voltage solenoid controls.

**COMPACT:** The ¼" port size takes no more space than a king-size package of cigarettes.

**SAFE:** Low voltage activation assures electrical safety to operator and machine. Solenoid controls guaranteed against burn out.

**FAST:** Speeds up to 2200 valve movements a minute.

The Bellows Electroaire* Valve gives design engineers a method of air control that is compact, fast, safe, flexible, positive and reliable. Taking no more space than a king-size package of cigarettes, it fits easily into cramped quarters or on moving machine elements. The Electroaire Valve is bullet fast, yet it will operate hour after hour without hum or pounding. Low voltage operation simplifies wiring problems, and gives positive assurance of electrical safety for operator and machine. Sturdily built, the Electroaire Valve will give almost unlimited service. Records of 20,000,000 to 30,000,000 cycles are not uncommon.

The Bellows Electroaire Valve is made in three port sizes: ¼", ⅜", ½". It can be arranged for direct connection to or remote control of any air cylinder of suitable capacity.

The Bellows Electroaire Valve is a built-in feature of all Bellows "Controlled-Air-Power" Devices arranged for electrical control.

**Write for these**

**FREE BULLETINS**

Case histories, wiring diagrams, technical data on the Electroaire Valve and other Bellows pneumatic equipment. Ask for Bulletins AV-300 and CL-30. Address: The Bellows Co., Dept. AH952 Akron 9, Ohio.

*TM REG. PAT. PENDING 1292

**The Bellows Co.**

ESTABLISHED 1

AKRON 9, OHIO

FIELD ENGINEER OFFICES IN ALL PRINCIPAL CITIES

# POST SCRIPTS OF INDUSTRY

## NEWS · VIEWS · TRENDS

**James H. Binger** has been named vice president of **Minneapolis-Honeywell Regulator Co.** with headquarters at the Minneapolis plant. Previously, he was vice president and general manager of the Belfield Valve division of the company.

**Leinart Engineering Company,** Knoxville, Tennessee, has been named distributor for "O" rings by The Parker Appliance Company, Cleveland. Leinhart Engineering Company, already a distributor of Parker industrial tube fittings, will stock Parker industrial "O" rings.


SPRAGUE HYDRAULIC BOOST PUMPS

FROM 3500 TO 50,000 PSI.

| Assembly No. | Ratio | Recommended Air Pressure | Maximum Fluid Pressure |
|---|---|---|---|
| 216-C- 35 | 35:1 | 100 PSI. | 3,500 PSI. |
| 216-C- 60 | 60:1 | 100-150 PSI. | 6,000 PSI. |
| 216-C-100 | 100:1 | 100-150 PSI. | 10,000 PSI. |
| 216-C-150 | 150:1 | 100-150 PSI. | 15,000 PSI. |
| 216-C-200 | 200:1 | 100-150 PSI. | 20,000 PSI. |
| 216-C-300 | 300:1 | 100-150 PSI. | 30,000 PSI. |

Model 216-C measures 8¼" wide, 9⅛" deep

6 Standard Models for Output Fluid Pressures to 30,000 PSI. From 100-150 PSI. Plant-Supplied Air Pressure. Boost Pumps with Capacities to 50,000 PSI. Supplied on Special Order.

Broadly applicable for static testing, powering presses for metal forming, shearing, clamping, etc. This standard model available for either oil or water service, where low volume output at high pressure is the requirement. Thousands in use. Simple... Reliable... Inexpensive.

SPRAGUE GAUGE PROTECTOR SHUT OFF VALVE

Automatically cuts out gauge from system when hydraulic or pneumatic pressure goes beyond its operating limit. Automatically opens when pressure is again within operating range of gauge. Available for low pressures—30, 60, 100, 200 and 300 PSI. and high pressures —500, 1000, 1500, 2000, 2500, 3000 and 5000 PSI. (Cut-in point approx. 80% of set cut-out point.) Write today for bulletin.

DISTRIBUTORS—New York, Philadelphia, Cleveland, Dayton, St. Louis, Chicago, Logansport, Dallas, Seattle. CANADA—Exclusive Distributor: Rousseau Controls, Ltd., Montreal Airport, P. Q.

1144 West 135th St., Gardena, California

SPRAGUE Engineering and Sales Corp.


**Robert P. Smith & Company,** 2031 Hendricks Ave., Jacksonville, Florida, has been appointed by the Allen-Bradley Company of Milwaukee as Florida distributor for motor controls. **C. R. Lee** is associated with **R. P. Smith** and will handle distributor accounts. A branch office at 121 S.E. First St., Miami, Florida, is in charge of **C. M. Converse.**

**Kenneth Sloan** has been moved from the home office to the New York office at 55 West 42nd St., New York City by the **George D. Roper Corporation** of Rockford, Ill. Mr. Sloan will be responsible, under District Manager Robert L. Moog for pump sales in eastern New York, northern New Jersey and Connecticut. Mr. Sloan, whose former post was sales office manager, Pump Division, has been with the Roper organization since 1945.

K. Sloan

**J. V. Koski** has been appointed chief engineer of the **International Metal Hose Co.,** a division of Gabriel Co. For the past seven years he was chief draftsman for Gabriel.

**Ralph I. Cole** and **Vernon C. Weihe** have joined the engineering staff of **Melpar, Inc.,** Alexandria, Va., subsidiary of Westinghouse Air Brake Co. Cole was formerly technical director of the Rome Air Development Center; Weihe was with Air Transport Association as systems engineer.

**Fluid Controls, Inc.**, of Willoughby, Ohio, announces that its president, Oliver G. Lear, has severed his affiliations with the Aluminum Cooking Utensil Company, division of the Aluminum Company of America, to take a more active part in the management of Fluid Controls.

O. G. Lear

Mr. Lear became associated with the Aluminum Cooking Utensil Company in 1933. His most recent assignment was as New England District Sales Manager. He has been a director and officer of Fluid Controls since its inception.

**E. E. Reagle** has joined the technical staff of the sales department of the **Tubular Products Division of The Babcock & Wilcox Company**, according to an announcement by W. J. Thomas, general sales manager of the division. Mr. Reagle was associated for a number of years with Sharon Steel Corporation as general superintendent and as manager in charge of specialty sales.

**Allis Hydraulic Products, Inc.** has been organized to design and build air and hydraulic cylinders, specializing in the production of cylinders to customers specifications and those of their own design to meet specific application requirements. Main offices are located at 1721 East Lake Bluff Blvd. Milwaukee, with manufacturing facilities at Waukesha, Wis. Sales will be handled through manufacturers agents established in principal cities. **William W. Allis**, previously active at the Allis-Chalmers Manufacturing Co. and having interest in several local manufacturing companies is the president and general manager. **G. A. Markuson**, formerly president of Hydro-Line Mfg. Co., Rockford, Ill., is vice president and sales manager.

**C. B. Hunt & Son, Inc.** has appointed three new representatives: Circle Seal Supply Co., 2181 East Foothill Blvd., Pasadena, California for the southern California territory; Process Equipment Co., 1663 Central St., Denver for Colorado, Wyoming, and parts of Montana and New Mexico, and Pollard and Co., South 121 Madison St., Spokane for eastern Washington and parts of Idaho.

**Herbert B. Hummer** has been named director of research by the Durametallic Corporation of Kalamazoo, Mich. Hummer comes to Durametallic from the Norwood, Ohio plant of Allis Chalmers Mfg. Co.

**Richard E. Stockwell** has become editor of Monsanto Magazine, published by **Monsanto Chemical Company.** Stockwell had been editor of Aviation Age

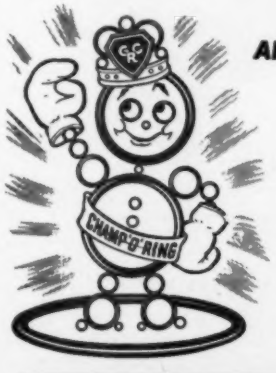

HIGH PRESSURE

a pushover for

GRC 'O' RINGS

HEAP BIG NEWS

**By telephone . . . by telegraph . . by sound wave or smoke signal, it's an established fact that GRC "O" Ring's high crush resistance . . . low permanent set . . . accuracy to close tolerances insure perfect sealing and securely seal high static pressures, reciprocating pressures, shock, surge, drop and vacuum.**




***AND THAT'S NOT ALL . . .***

***GRC compounds are designed to withstand a wide range of conditions: air, water, oils, aromatic fuels, gases, refrigerants, ammonia, heat, cold, friction, twist . . . to mention a few.***

***The complete story will be sent by mail (not smoke signal). Ask for Catalog "C".***

Goshen Rubber Company INC.

MOLDED • DIE CUT • LATHE CUT RUBBER SPECIALTIES SINCE 1916

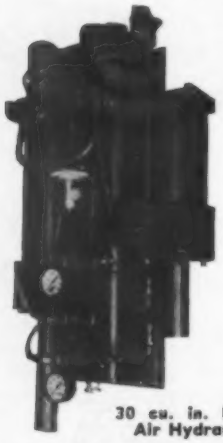
**1592 S. TENTH STREET • GOSHEN, INDIANA**

magazine in New York. Previously he was an editorial writer for the Minneapolis Star and has been associated with several radio stations.

**Adel Division, General Metals Corporation,** has announced the appointment of **Robert O. Borst** as sales engineer for the Pacific northwest and California area. Included in his twelve year background of engineering and sales experience is his association with J. C. Carter Co., as chief project engineer and the National Steel and Shipbuilding Corp., as manager of manufactured products division. Previous to his appointment Borst also served as project engineer with Adel. Also announced was the appointment of **George Shy** as development engineer with headquarters at the Huntington, West Virginia plant. In addition to his duties in Huntington in the field of new developments, Shy will head an active program to broaden utilization of Adel eastern manufacturing facilities.


# CUSTOM DESIGNED AND BUILT THE CENTURY WAY

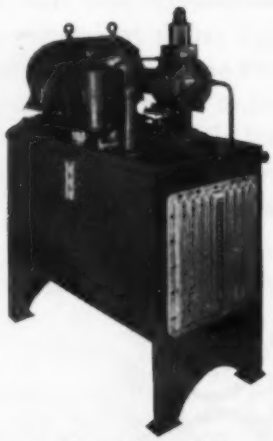
The two units illustrated were designed and built to meet specific applications in the plants of one of the Big Three automobile manufacturers. Their dependability and freedom from down-time reflects the advantage of engineering "the CENTURY way."



30 cu. in. Double-Acting Air Hydraulic Booster

This unit, or any modification to meet your own requirements, offers a complete, simple power package for developing hydraulic pressures up to 30,000 psi from ordinary shop air supply. The package includes the reservoir, air regulators, and solenoid-operated control valves for stroke reversal.

CENTURY specializes in 30- to 500-gallon reservoir units with any makes or combinations of commercial components, designed to meet your needs and specifications. The complete unit illustrated consists of a 10 HP, 1200 RPM, AC motor; a 30-gal. pump; a clarifier unit, and an 80-gal. reservoir. Over 150 of them are in daily use in the plants of one of the Big Three.



Deluxe Hydraulic Package Unit

**Bring us your problem; remember: if it's hydraulic, CENTURY designs and builds it—to J.I.C. standards.**

CENTURY HYDRAULICS, INC.


The **Cleco Division of the Reed Roller Bit Company,** has announced the appointment of Oliver H. Van Horn Company, 1742 St. Charles Ave., New Orleans 1, Louisiana; and Peerless Supply Company, Inc., Shreveport, Louisiana; Bethlehem Supply Company, Inc., Bethlehem, Pennsylvania, as distributors for Cleco products in their areas.

The appointment of **Carl S. Abbott** as vice-president and general manager and **John W. Fauver** as vice-president and sales manager of the **J. N. Fauver Company, Inc.,** has been announced. Abbott who was formerly sales manager has a background of fourteen years' experience with the organization.

C. S. Abbott

J. W. Fauver

Prior to joining the company, he spent two years with Carbide Chemical. Fauver has been with the company seven years and was previously in the ordnance department.

**Standard Pressed Steel Co.,** has named three additional sales representatives to handle all standard products in territories in the east, midwest and the Pacific coast. Marshel Moorhouse has been assigned the New York City territory, Walter H. Cunnington will work out of St. Louis and handle sales in middle Illinois, Missouri, Kansas and parts of Iowa. James C. Humphries will sell for the company in California, Washington and Oregon, with his headquarters in Los Angeles. Francis J. Kinsella, sales manager in the Detroit territory, has been appointed to the newly created post of regional sales manager for SPS in the midwest. Suc-

ceeding Kinsella as manager is Daniel F. Hulgrave, Jr., who has been with the sales organization in Detroit since 1949.

Negotiations are under way for the acquisition of the **La Plant-Choate Manufacturing Company, Inc.,** by **Allis-Chalmers Manufacturing Company** according to an announcement by A. D. Dennis, president of La Plant-Choate Mfg. Co. In a letter sent to all stockholders, Dennis and Roy E. Choate, chairman of the firm's board of directors said that direct negotiations are being conducted with the Allis-Chalmers Manufacturing Company and were looking toward the acquisition by Allis-Chalmers of the plant and assets of La Plant-Choate, or some arrangement for an exchange of stock, merger or consolidation.

**M. E. Ziegenhagen** has been named advertising and sales promotion manager of **Worthington Corporation.** Ziegenhagen has been associated with General Electric Corporation since his graduation in 1937. Since 1946 he has been in charge of advertising and sales promotion for several of the product departments of General Electric's Schenectady plant.

M. E. Ziegenhagen

**F. E. Peltier** has been appointed manager of Central Regional Engineering and Service, for the Worthington Corporation with offices in Cleveland. Peltier will supervise the engineering and service in the company's district office territories of Detroit, Cleveland, Cincinnati, Buffalo and Pittsburgh. Since 1949 he has been an application engineer on high pressure hydraulic systems in the centrifugal and reciprocating pump division of Worthington Corporation.

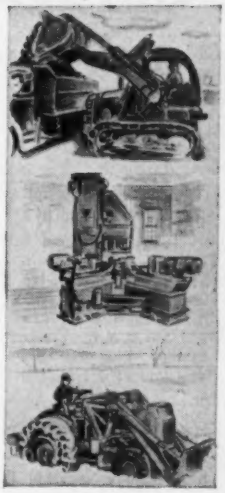
**The New York Belting and Packing Company** has joined forces with the **L. H. Gilmer Company.** The new organization will continue to operate and be known as the New York Belting and Packing Company. Gilmer products will retain the Gilmer name and will be sold by the new organization. **B. F. Ruether,** vice president of the New York Belting & Packing Company, will be in charge of the expanded organization.

**George Gilliam and C. J. Smolinske** have been named to industry sales manager posts for the industrial division of the **Minneapolis-Honeywell Regulator Company.** Gilliam will be in charge of the company's products for all types of engines and test facilities. Smolinske will be industry sales manager for pyrometer supplies, a post formerly held by Gilliam. Both will make their headquarters in Philadelphia.


*The Right Combination, for All Hydraulic Equipment*

**MULCONROY Hydraulic HOSE ASSEMBLIES and "PRESS-LOCK" Couplings**

With "Press-Lock" Couplings attached, Mulconroy Hose Assemblies provide a new measure of safety, efficiency and economy for all operating or control lines on every type of hydraulic equipment. They are available in three basic hose constructions, to meet any required working pressure; in a full range of sizes and in lengths up to 50 feet. Quickly and easily installed by attaching standard male threaded end of each "Press-Lock" Coupling.



The outstanding success of "Press-Lock" Couplings on Mulconroy Hydraulic Hose Assemblies, in the widest possible range of applications, is evidence of their important contribution to the Hydraulics field.

Cut-away view shows unique construction of the "Press-Lock" Coupling. Note that entire hose wall is utilized—a vital contribution to superior strength and durability.

Three-way gripping efficiency is provided by the "Press-Lock" Coupling, as follows: Inner section of hose wall is pressed into corrugations on stem; outer hose wall, with reinforcing wire, is displaced under pressure into openings in coupling sleeve; sleeve is anchored to collar on stem, back of hex portion. Because the entire hose structure is employed in attaching the "Press-Lock"—no part cut away—hose will withstand shock loads and continuous flexing far beyond the limits attainable by use of conventional type couplings for this service.

***Write for Illustrated Catalog***

**"MULCONROY *Starts...*** **WHERE OTHERS *Stop!*"**

**MULCONROY CO.** *Hose Specialties Since 1887*

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Los Angeles STANDARD Rubber, Inc.

KOBE Heavy Duty High Pressure

# Triplex Pumps

*Case History A10:* Los Angeles Standard Rubber, Inc. has used a Size-3 Kobe Triplex since September, 1942. The Company manufactures molded rubber products for the aircraft, oil well and refrigeration industries. The Kobe unit is called upon to operate 24 presses intermittently 24 hours a day, 5 days a week, at 2200 p.s.i.

*Reliability Praised*

The rugged dependability of the Kobe Triplex is praised in these terms by a company spokesman for Los Angeles Standard Rubber, Inc., "Your Kobe Pump is a vital asset to a critical operation where dependable, day-in, day-out performance, without danger of breakdown, is a must. We especially like the parts interchangeability feature."

*For power when you need it, specify Kobe.*

*Triplex Features*

- Pressures—To 5,000 psi (standard) To 20,000 psi (special)
- Volumes—To 60 g.p.m.
- Power Ratings—15, 30, and 50 H.P.
- Integral Double Reduction Gears
- Integral Electric Drive (Optional)
- Easily interchanged Plungers and Liners

*Write for Bulletin*

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KOBE INC.
Division of Dresser Equipment Co.
Plant: Huntington Park, Calif. — Representatives in CLEVELAND, Pittsburgh, New York, Houston, Oklahoma City.


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Haskel Engineering Associates
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Circle 23 on Reader Service Card

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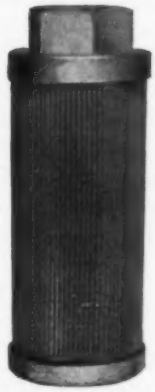

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Capital filters designed to J.I.C. standards are available in filtering capacities of 5, 8, 10, 20, 30, 40, and 50 gals. per minute. Larger capacity sizes can be supplied to meet special requirements. Get bulletin AH-1 for complete details

CAPITAL
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## New Publications

Continued from page 137

trated by 49 charts, diagrams, graphs and tables. Also included is a manual for a lower repair and maintenance cost program, prepared by Westinghouse Electric Corp.

The volume, which contains 182 pages, 8½ x 11, is available for $6.00 from Clapp and Poliak, Inc., 341 Madison Ave., New York 17.

The papers are divided into groups of general and specific interests and each group is followed with an elaborate question-and-answer section. General topics include costs, inspection methods and records, planning and scheduling maintenance work, and lubrication.

There are chapters on maintenance of electrical equipment; plant buildings; training maintenance workers and supervisors, and project preparation and cost control. Separate treatment of maintenance problems, according to the size of the plant, is given in five chapters, beginning with plants employing less than 50 maintenance workers, and ending with plants having more than 800. Chemical, steel and automotive plants have separate chapters. Maintenance of hydraulically powered equipment in these plants is discussed.

### Tractor Design

The first book on tractors written on a technical engineering level, "Tractors and Their Power Units" has been published by John Wiley & Sons.

Sponsored by Ferguson Foundation, the new volume is one of a group of textbooks designed to raise the level of agricultural engineering education. It gives a thorough treatment of the mechanics and dynamics of the tractor chassis. Principles and fundamentals are stressed, with descriptions limited to a minimum. The authors, E. L. Barger, W. M. Carleton, E. G. McKibben and Roy Bainer, concentrate on material that does not appear customarily in internal combustion engine books. Their study of air cleaners, transmissions, and tractor tests are entirely new. Similarly, their treatment of traction and traction devices, and dynamics of chassis, does not appear elsewhere.

"Tractors and Their Power Units"

Continued on page 156


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# APPLIED HYDRAULICS Data Sheet

**For Your Pneumatic and Hydraulic Design Notebook**

## Hydraulic Oil Performance Properties

### *Viscosity Index . . .*

expresses change in viscosity with change in temperature. The higher the V. I., the smaller the change in viscosity with a given change in temperature. V. I. is a relative term with zero assigned to each of a series of certain naphthenic oils termed the L series and 100 assigned to each oil in a certain series of paraffinic oils called the H series.

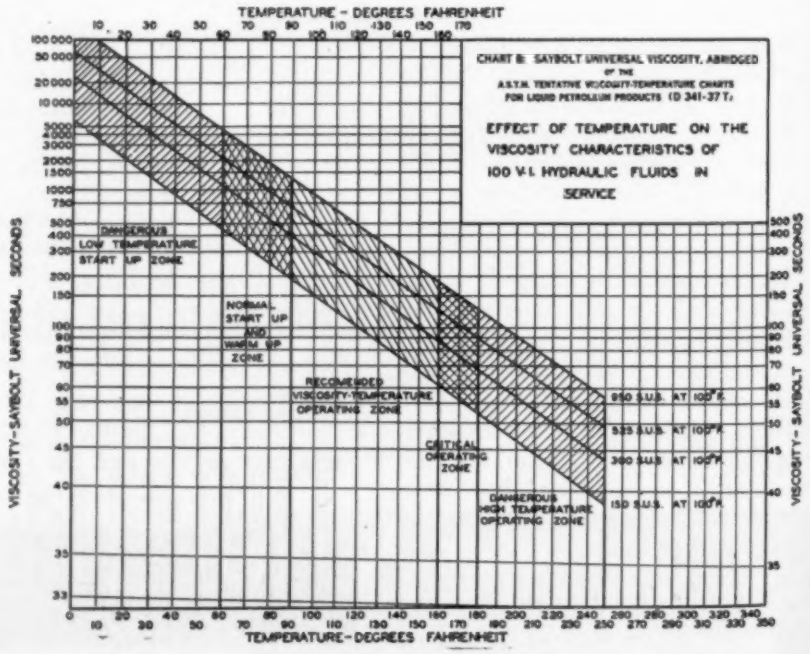
Introduction of new processing methods have produced oils having V. I.'s greater than 100 and less than 0. Viscosity Index of an unknown oil may be calculated from the following formula:

$$\frac{\text{V.I.}}{100} = \frac{\text{diff. betw'n 100F viscosities of L series and unknown oil}}{\text{difference between 100F viscosities of L and H series oils}}$$

To use this formula the viscosity of the unknown oil at 210F and 100F must be known along with the viscosities at 100F of the L and H series oils which have the same viscosity at 210F as the unknown oil. Tables issued by the (ASTM D 567-41) quickly provide numerical values for substitution in this formula

### *Viscosity . . .*

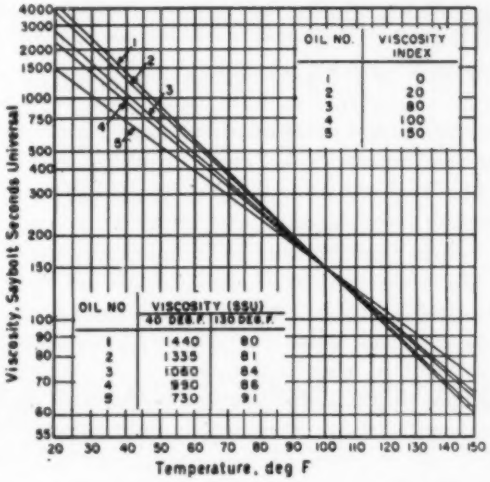
is the measure of an oil's resistance to flow. Viscosity must be expressed as a certain value at a certain temperature. The most common viscosity unit is the Saybolt Universal Second, SSU. For hydraulic oils, the Saybolt viscosity is the number of seconds it takes for 60 cubic centimeters of the oil to flow through a hole of specified diameter and length. Saybolt viscosity for hydraulic oil is taken at 100F. The lower the Saybolt number, the lighter or "more fluid" the oil.


TEMPERATURE - DEGREES FAHRENHEIT
CHART B: SAYBOLT UNIVERSAL VISCOSITY, ABRIDGED OF THE A.S.T.M. TENTATIVE VISCOSITY-TEMPERATURE CHARTS FOR LIQUID PETROLEUM PRODUCTS (D 341-37 T)
EFFECT OF TEMPERATURE ON THE VISCOSITY CHARACTERISTICS OF 100 V.I. HYDRAULIC FLUIDS IN SERVICE
DANGEROUS LOW TEMPERATURE START UP ZONE
NORMAL START UP AND WARM UP ZONE
RECOMMENDED VISCOSITY-TEMPERATURE OPERATING ZONE
CRITICAL OPERATING ZONE
DANGEROUS HIGH TEMPERATURE OPERATING ZONE
950 S.U.S. AT 100°F.
525 S.U.S. AT 100°F.
300 S.U.S. AT 100°F.
150 S.U.S. AT 100°F.
VISCOSITY - SAYBOLT UNIVERSAL SECONDS
VISCOSITY - SAYBOLT UNIVERSAL SECONDS
TEMPERATURE - DEGREES FAHRENHEIT

Effect of temperature on viscosity for hydraulic oils having 100 V. I. The recommended operating zone is established on the basis of maximum pump efficiency.
*Courtesy E. F. Houghton Co.*

Although SAE ratings are not applied to hydraulic oils, some operating personnel are more familiar with these ratings than with Saybolt. Here's a chart giving you a comparison between Saybolt and SAE ratings.

| | S.U.S. Vis. at 130° | S.U.S. Vis. at 210°F. |
|---|---|---|
| SAE 10 | 90 - 120 | |
| 20 | 120 - 185 | |
| 30 | 185 - 255 | |
| 40 | 255 min. | 80 max. |
| 50 | | 80 - 105 |
| 60 | | 105 - 125 |
| 70 | | 125 - 150 |


Viscosity, Saybolt Seconds Universal
Temperature, deg F
OIL NO. | VISCOSITY INDEX
1 | 0
2 | 20
3 | 80
4 | 100
5 | 150
OIL NO | VISCOSITY (SSU) 40 DEG F | 130 DEG F
1 | 1440 | 80
2 | 1335 | 81
3 | 1060 | 84
4 | 990 | 86
5 | 730 | 91

Viscosity temperature curves of five petroleum oils ranging in V. I. from zero to 150.

*Courtesy Socony-Vacuum Oil Company*

### *Stability . . .*

of the oil must be high so that it can resist the effects of heat, moisture, air turbulence and other contamination.

### *Pour Point . . .*

is associated with viscosity. Pump manufacturers recommend that the pour point be 15F to 20F below the lowest anticipated operating temperature.

### *Neutralization Number . . .*

is used as a rule of the thumb test to determine the useful life of a hydraulic oil. Since it indicates the degree of acidity, a neutralization number of over .5 serves as a "time to drain" indicator.

### *Demulsibility . . .*

is the ability of an oil to separate from water. The higher the demulsibility rating the more quickly does the oil separate from water.

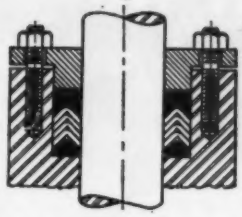
### *Other Properties . . .*

You want an oil which provides sufficient lubrication to pump and valve parts, has a suitable rust inhibitor, and resists foaming.

For hydraulic oils, both color and carbon residue give some indication of breakdown. If your equipment is in a hot area, you'll want to check the oil's flash and fire points.


Circle 55 on Reader Service Card

**V-DAPTORS**



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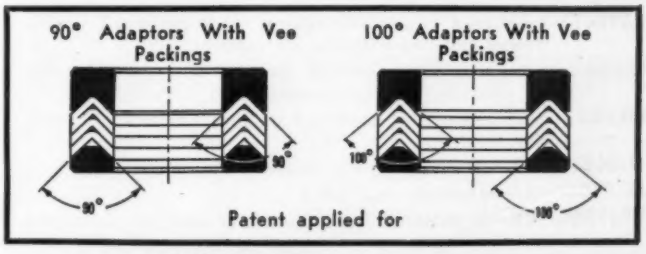
RODgers BRONZE V-daptors With Vee Packings in typical Stuffing Box installation.

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**SPRING LOADED** WITH SQUEEZE G-R-I-P Action

**Squeeze Grip Action Does It**

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**The Fall Wiper Ring is available from ½" to 13" dia. Military part numbers from AN6231A1 to AN6231A71. Write, wire or phone us regarding your wiper needs.**

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**. . . a low-cost combination for compressed air lines**

**PROTECTS** air-driven equipment against "dry running" breakdowns and impurities in air supply.

**CLEANS** air automatically through permanent type, cleanable filter element. No replacements ever required.

**INJECTS** proper amount of atomized oil into the line automatically.

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# Simplify Circuits For Limited Specs

Concluded from page 65

lator. When electrical is completely shut off the ram is supported by oil trapped between the ram and check valve (9).

When the operator presses the start button, both solenoids are energized and the valve spool shifts to open both cylinder ports to tank and block the pressure port. Rapid approach takes place with oil driven from the prefill tank by 80 psi air pressure. The ram stroke takes 1¼ seconds. Approximately ¼ inch from the bottom of the stroke, a limit switch is tripped to deenergize solenoid 2. The valve shifts to open pressure to ports B and A to tank.

By the use of orifices, oil pressure will close off valve (5) before shot cylinder (6) moves. Valve (5) closes at a controlled rate to avoid shock and serves to control the rate at which the press ram goes into slow speed. Also this valve controls opening speed to prevent the ram from running away when bumping.

The 4 inch diameter shot cylinder supplies 800 psi oil for the slow squeeze. Large volume oil delivery from the prefill tank is cut off by the high pressure oil which closes check valve (7). Bumping is controlled by the setting of electrical timers which deenergize and energize solenoid 2. When solenoid 2 is deenergized, solenoid 1 held energized, pump pressure oil is exerted on the rod side of the ram to raise the press. Because valve (5) opens slowly, the ram does not rise rapidly and before valve (5) can open, the bump control timers operate to reenergize solenoid 2 and start the ram down. The resulting bumping motion is a "breathing" action. At the end of the curing time, solenoid 2 is held deenergized and the ram raises under pressure of oil from the pump and accumulator. Pressure on the rod side opens pilot check (7) to permit oil from the blank end to return to the prefill tank.

Each of the five presses operate independently having a common prefill tank and pump unit. A study of the limited operating requirements made possible the development of this unusual circuit which operates with a 12 gpm hydraulic pump charging a 5 gallon accumulator and an air-over-oil prefill system.

# Revamped Stretch Press

Concluded from page 98

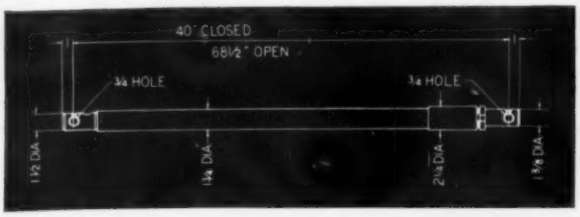
the hand-screw jacks were removed from the stretch press, the jack center sections cut out, trued up and welded into the hydraulic ram assembly. Plates already attached to the jacks were jig-bored for hinge holes and pins, previously ground, were fitted to the holes. With the hook up of the hose lines from the portable pump to the ram cylinders, the installation was complete.

Production tripled over the handscrew production rate; production was adequate on the heavier sheets.

*Acknowledgements*: The editor is indebted to Ed Laurance, Detail Manufacturing, and C. W. Harvey, Machine Maintenance, for essential data regarding this ingenius modification.

Circle 152 on Reader Service Card

# FOR SALE
## HYDRAULIC CYLINDERS
### Only 3000 available

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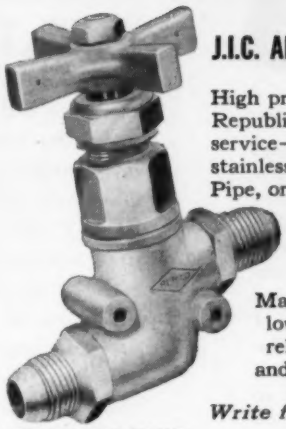

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High pressure needle and globe valves by Republic have forged bodies for super duty service—brass, steel, aluminum alloy, or stainless steel. Exclusive design features. Pipe, or AN or J.I.C. tube ends, or combinations, sizes ⅛" to 1". Operating range: needle—3,000 psi; globe—2,000 psi, −65° to 350°F.

Manufacturers also of high quality low and hy-pressure check valves, relief, 2, 3, and 4-way plug valves, and special valves to specifications.

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Has 3-1/2 GPM capacity at 600 PSI. Motor is 1½ HP, 24V, D.C. Will operate on either 12 or 32V, DC current. Has built-in relief valve adj. to 1500 PSI. This unit ideal for hyd. lifts, portable loaders, etc. ..... 19.50

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Operating pressure 2000 PSI. Cap., 1.5 cu. in per complete cycle .. 12.75

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Burd *Hydra-Seal* Piston Rings perform better, longer, in hydraulic cylinder operation. *Hydra-Seal* Rings seat rapidly, positively eliminate gap leakage, offer complete freedom from face leakage with no undesirable pattern of radial pressure. May we submit the benefit of our hydraulic piston ring experience as applied to *your* equipment? There's no obligation.

Let us send you this FREE bulletin on Piston Ring Seals in Hydraulic Cylinders. Write for Bulletin H-2.

BURD PISTON RING CO.
DIVISION OF THE GABRIEL COMPANY
ROCKFORD ILLINOIS

Continued from page 151

contains 496 pages and is priced at $6.50.

## For Sales Engineers

Bernard Lester has written a 255 page, pocket size book, titled "Selling to Industry", as a manual of practical ideas and suggestions for the sales engineer who wants to analyze and improve his methods of finding, contacting, selling and servicing industrial customers.

As the author points out in his introduction, "Selling any prospect effectively does not follow a beaten path. Prospects and salesmen vary in temperament, habits and interests. Products sold differ, and new problems in their application and use continually crop up. But success in selling is not a haphazard affair. Proper preparation and orderly enthusiastic procedure are necessary." In this manual Mr. Lester has set forth in a brief and realistic way those key points which have, from experience, been found to be most effective.

"Selling to Industry" is published by the Industrial Press, New York City, priced at $3.50.

## Aldrich Pump Company Celebrates 50th Year

The Aldrich Pump Company, Allentown, Pennsylvania, is one of the oldest and one of very few companies specializing in the manufacture of reciprocating power pumps. This company was originated as The Aldrich Pump Department of The Allentown Rolling Mills. The latter Company, with a background of almost one hundred and seven years, ended its existence on November 30, 1951 through merger into The Aldrich Pump Company.

Among many outstanding developments, Aldrich was first to produce high speed pumps with crankshaft speed of 60 rpm (1903) and 120 rpm (1918). The company was also first to develop porcelain plungers, to develop the variable stroke triplex pump (1926), and to build 5, 7, and 9 plunger pumps, to advance crankshaft speed to 225 rpm (1939) and, in 1949, to design and build the direct flow pump with speed of 500 rpm for the 3 in stroke pump, 360 rpm for 5 in stroke pumps, and 300 rpm for 6 in stroke pumps.

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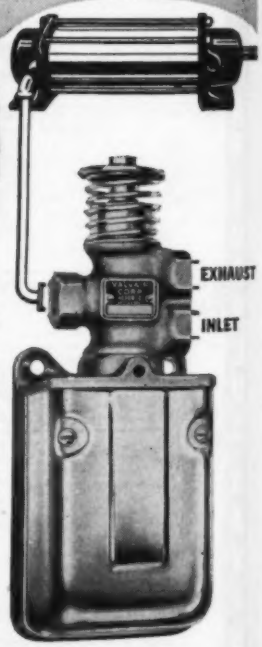


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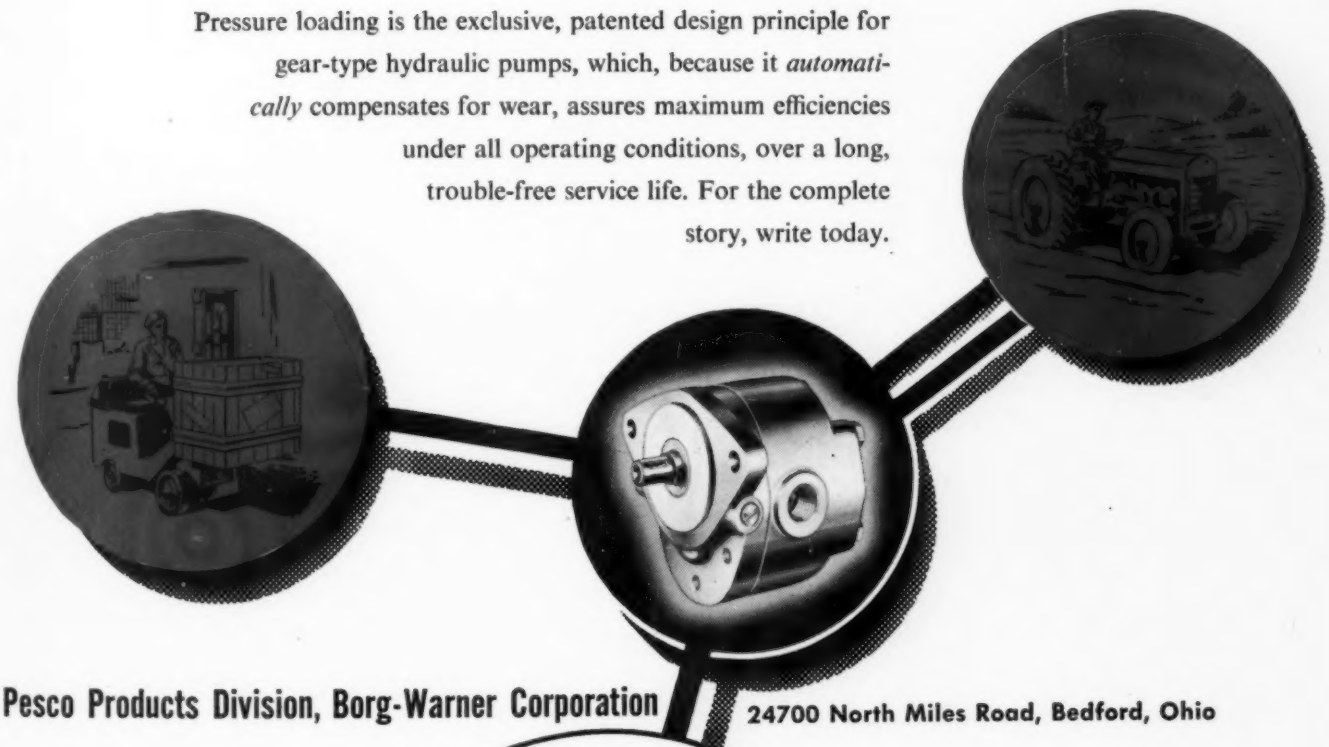

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